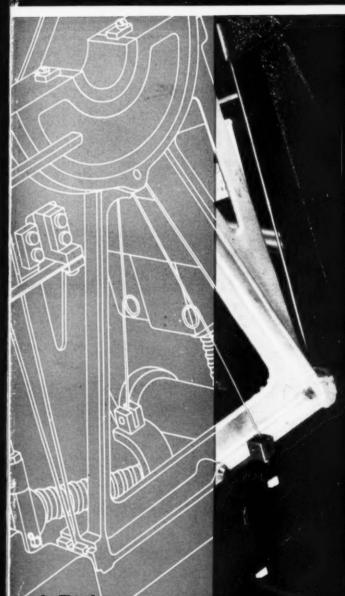
dlac. 49

## MACHINE DESIGN

December 1949



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HYDRAULIC PACKINGS COPPER-BASE ALLOYS SHOP RELATIONSHIPS BALANCING ACCURACY CIRCUIT ANALYSIS

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For machine designers.

New Cutter-Hammer Times

SMALL SIZE

EASY TO ADJUST

ACCURATE AND DEPENDABLE

### BULLETIN 10337 A. C. PNEUMATI

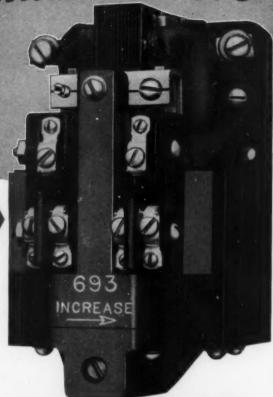
Designed for a broad variety of industrial control timing needs, such as machine tools, conveyors, automatic processing equipment, etc. Its extremely small size, 23/4 wide x 41/8 high makes it desirable where space is at a premium. Its timing adjustment is especially simple, made with a screw driver from the front. 8 turns of the screw gives the entire timing range from 0.3 seconds to 3 minutes. Reset is practically instantaneous. Available either with one timing step or two timing steps, the two steps eliminate the need of one timing relay. The two steps of timing are independently adjustable over the entire range.

### BULLETIN 13522 GENERAL PURPOSE ELECTRONIC TIMER

For use particularly where short or very accurate timing is required. The standard unit has a wide timing range, from 0.15 to 60 seconds. Shorter time settings or narrower ranges can readily be provided for special applications. Timing adjustment is easily made by turning knob of potentiometer rheostat which is equipped with a clearly graduated dial. The rheostat may be located inside the timer enclosure or at any convenient place on the machine remote from the timer. A heavy duty industrial type relay is used in the timing circuit. An outstanding feature is the extreme accuracy of the unit on repeat operations and under varying ambient temperature conditions.

For further information on Bulletin 10337 pneumatic timer, or Bulletin 13522 electronic timer, write CUTLER-HAMMER, Inc., 1310 St. Paul Ave., Milwaukee 1, Wisconsin. Associate: Canadian Cutler-Hammer, Ltd., Toronto, Ont.



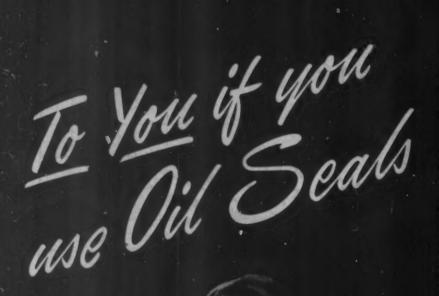




### 2055 peed Control Provides Split-Second Timing of Piston Movements by Positive Control of Air Flow 0 5 HUNDREDS CUBIC INCHES PER MINUTE Available in sizes 1/4" through 11/4" With air flow regulated by screw action, changes in volume take place with constant progression—not a series of "steps"-but with micrometer accuracy. Control of the air flow is absolute-from zero to maximum. Simple-dependable-rugged. Only two

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### **NACHINE DESIGN**

PROFESSIONAL JOURNAL OF CHIEF ENGINEERS AND DESIGNERS

This Month's Cover: View of floating work supports on Gisholt Dynetric balancing machine. Article discussing accuracy of balancing machines begins on Page 113.

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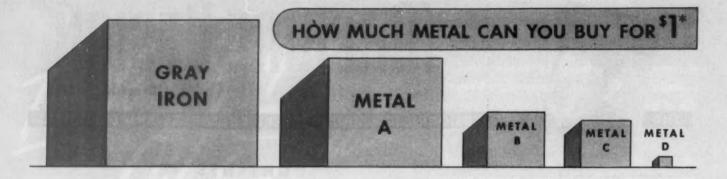
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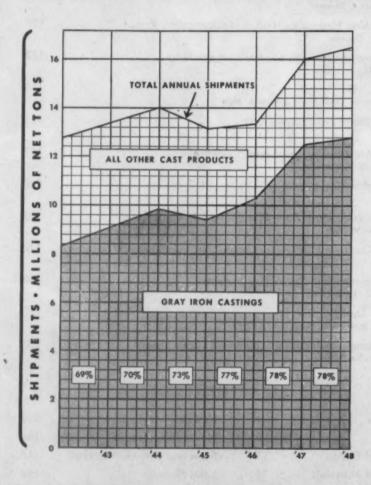
DESIGNING FOR PRODUCTION AND SALES . STYLING MATERIALS SPECIFICATION . DESIGN ANALYSIS MACHINE COMPONENTS . ENGINEERING MANAGEMENT

ANNUAL INDEX OF EDITORIAL CONTENTS..





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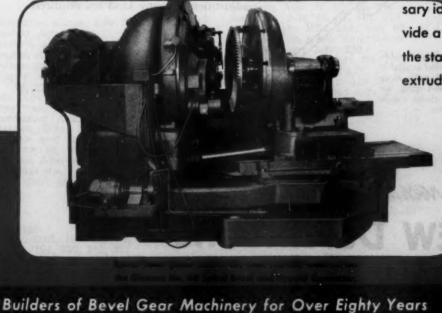
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Nothing Rolls Like a Ball

### NEW DEPARTURE BALL BEARINGS

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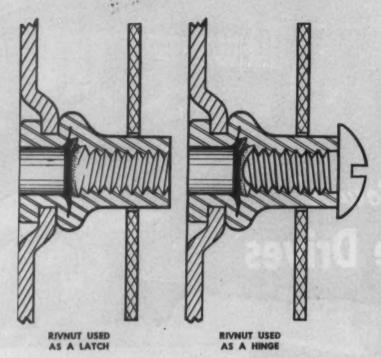
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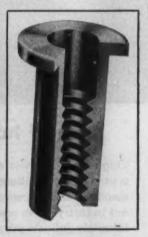
Chances are Rivnuts can solve your fastening problems, too. Get the help of Rivnut engineers. Write The B. F. Goodrich Company, Dept. MD-129, Akron, O.



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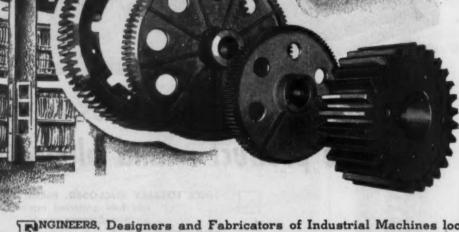
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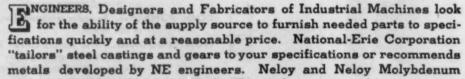
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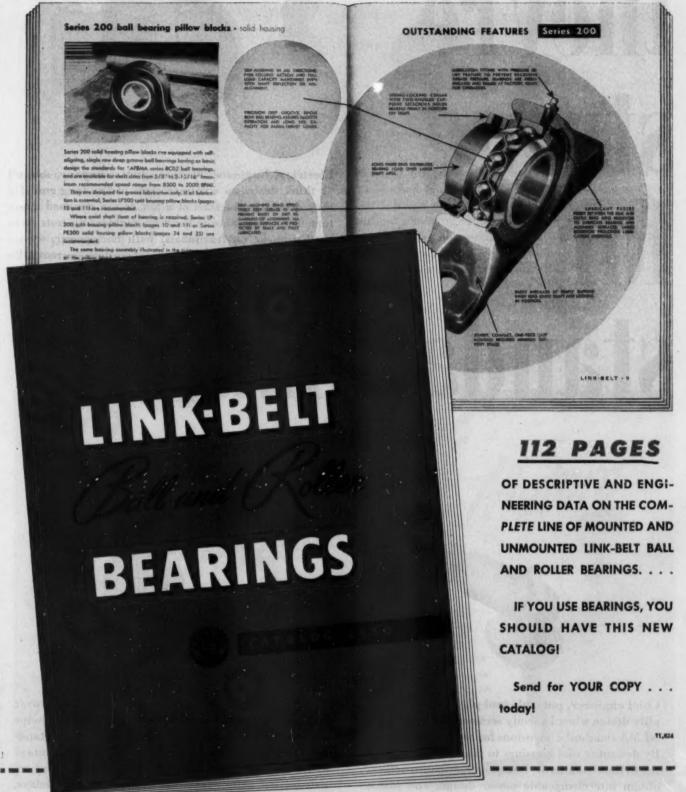
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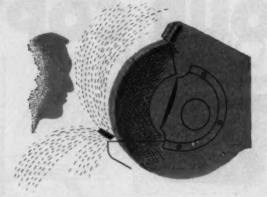
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## they're strong for



Electrical Engineer, machine tool company, says: "I think designers will save time in the long run if they decide, at the start of a job, to use standard motors. We'll eliminate exhaustive engineering tests we used to make on fractionals. With horsepower, service factor, breakdown torque, and starting current all rated on a clear-cut, uniform basis we'll know in advance that the motor will do the job."

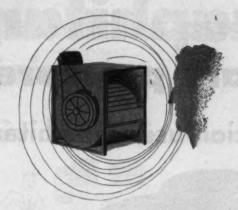
## standardization



Chief engineer, portable tool plant, says: "I simplify design when I specify series-motor parts with NEMA standard dimensions for our portable tools. By designing tool housings to take parts conforming to these standards, I simplify case construction, obtain interchangeable motor design, and lower overall costs."



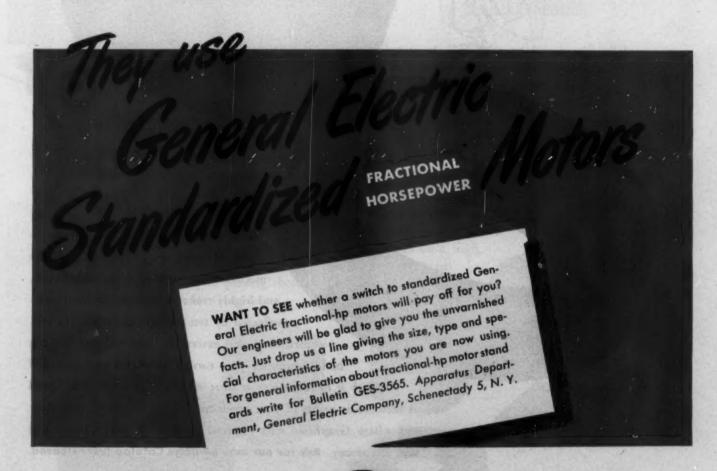
Vice-President, washing machine company, says: "The use of standard washing machine motors helps our dealers to give dependable service. With standard motors, the service man can take full advantage of the motor manufacturer's motor-exchange and repair-service plans—take the headaches, and delays, out of motor repairs or replacement. He can be sure that the motor he puts back on the job will perform as it should."



President, electric blower corporation, says: "The big thing about the new fractional-hp motor standardization plan, to me is that we stand a better chance of getting 'off-the-shelf' delivery of motors when they are a big-production item, instead of a special. Also, we eliminate special jigs and fixtures, and the need for making universal mounting bases and adapter plates."



Head of oil burner firm says: "Standardization of motors and parts is most important to our company. Our burners can be made in several sizes and types without changing the motor size or application, even when making improvements and new models. Standardization means lower production and inventory costs for oil burner manufacturer and distributor or dealer."





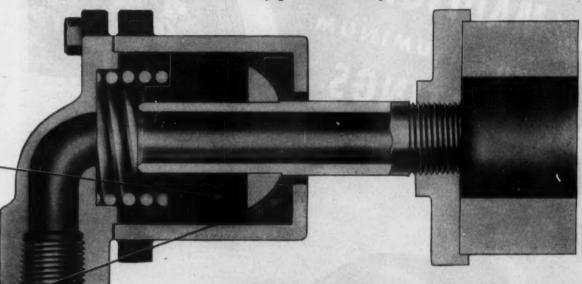
## graphitar graphite graphital gra

the Johnson Corporation uses Graphitar



### provides answer to design joint

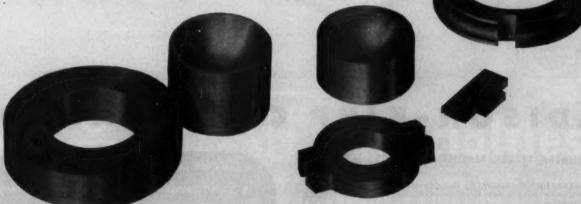
Guide and Seal in Type "S" joint



GRAPHITAR helped engineers of The Johnson Corporation lick a tough bearing and seal problem in a rotary pressure joint for certain types of calenders, waxers, saturators, and similar equipment. The construction of this type of equipment would not permit the use of supports for the well-known standard Johnson Rotary Pressure Joint which is equipped with Graphitar seal rings.

So here's how the Type "S" Johnson Rotary Pressure Joint was designed to solve this problem. A Graphitar guide accurately fitted into the joint body, as illustrated, provides sufficient support. The convex

surface of the collar mounted on the roll rotates against a matching concave Graphitar ring. The result is a tight, leak-proof seal that assures long-term service, because tough, strong Graphitar takes on a high polish under load and defies wear. No oiling or greasing is necessary, since the liquid passing through the joints acts as a perfect lubricant for Graphitar.



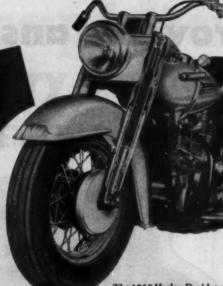
DIVISION OF THE WICKES CORPORATION . SAGINAW, MICHIGAN

The Telling Touch of Eye Appeal!

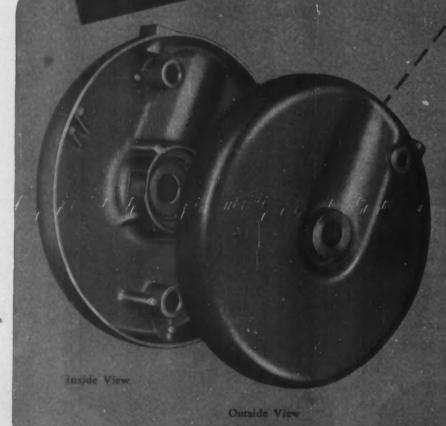
with MADISON-KIPP

ZINC and ALUMINUM

DIE CASTINGS



The 1950 Harley-Davidson Hydra-Glide Motorcycle



The front brake side plate on this popular new motorcycle is an excellent example of the plus values, which designers can so often get in Madison-Kipp die castings. The high strength, accuracy, and functional bosses and recesses are inherent values. The lightness and the eye appeal are extra values.

If you use metal parts in sizable quantities, you are invited to send your blueprints to our home office in Madison for analysis.

### MADISON-KIPP CORPORATION

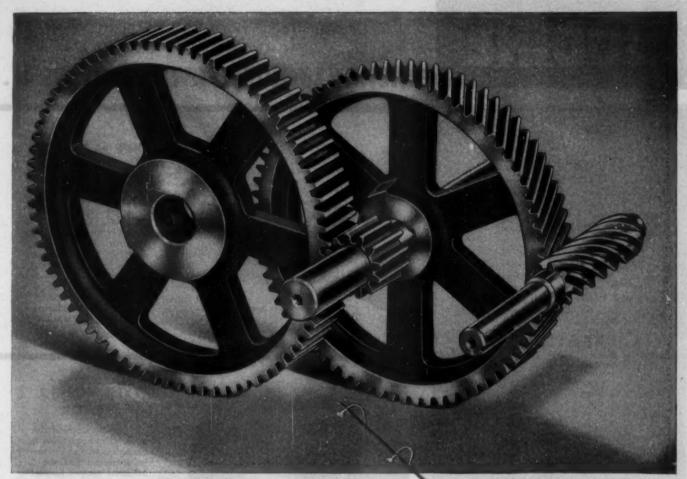
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ANCIENS ATELIERS GASQUY. 31 Rue du Marais. Brussels, Belgium, sole agents for Belgium, Holland, France, and Switzerland.

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- Originators of Really High Speed AIR TOOLS



## GEARS that help Kill



The value of Insecticide Dusting for cotton and many other important crops has been proved beyond all question. Where breakdown or power failure could mean a sharply depreciated or lost crop, SIMPLEX MANUFACTURING COMPANY can take no chances. They specify G.S. for the Gears in their popular Insecticide Dusters, for smooth, trouble-free performance, for rugged dependability day in and day out. You'll find G.S. Small Gears in all types and kinds of products—those you use in your own home, those used in industry, in agriculture. Wherever long life, dependability, and quieter, smoother operation are factors, G.S. Small Gears are the right answer to the power problem. Our thirty years of experience in specializing on Fractional Horsepower Gears is yours to command. Let a G.S. Engineer give you ideas, suggestions, cost estimates. No obligation. Write or phone, today!

SEND FOR free G. S. catalog-bulletin, describing many different types and applications of our Fractional Horsepower Gears.



### BODINE

### FRACTIONAL HORSEPOWER MOTORS

BOOTING Electric Company has a read an environe reportation throught out industry as designed and manufacture of high-quality fractional has reported motion. Nearly a half-transacy's experience has given us the know have to provide you with motors has stated to your particular application. Bealing matters are used on many of the nation's leading products. Experienced application engineers are always at your disposal to help solve the motor application problems.

### FEATURES

- Motors engineered to your product.
- Broad line of motors to select from over 3500 standard specifications from 1/2000 to 1/6 hp.
- Quiet operation, reliable, troublesfree, precision-made.
- Whether a.c. or d.c. the frame is the same size—same mounting dimensions — 100% interchangeabitive.
- Compact, dependable power in smallest possible space a standard frame for each horse-ower rating.
- Wide range of gear resion available with each type and size of motor more reducers within our range than any other manufacturer's.

### AVAILABILITY

Bestine process in most of the popular specifications, can be supplied from such. Others can be produced in 6 to 12 wishes east motors, to A wishes, Boding in Aropared to supply motors to meet your production or gally motors.

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#### TYPE N MOTOR

Available in three basic sizes. Smallest motor is 3½" in diameter, largest is 5½". Almost any type of winding. Standard ratings from 1/150 to 1/6 hp at 1725 rpm. Used on such devices as blowers, pumps, coin handling equipment, communication equipment, therapeutic devices, sound-recording and reproducing equipment, and machine tools.



### TYPE VCF-12 MOTOR

Normally supplied with series windings having variable-speed characteristics and nominal speed of 5000 rpm. Compact (2½" high), generous power, lightweight, small enclosure. Operates such devices as adding machines, calculating machines, check protectors and motion-picture projectors.

SPEED



Group 7: Rugged reducer for driving heavy loads continuously. Ample reserve for overloads. Height, 71/8". Eight different windings.

### ENGINEERED FOR YOUR PRODUCT



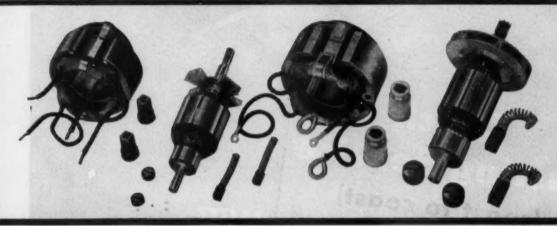
### TYPE K MOTOR

Without speed reducer: Normal 60-cycle output ranges from 1/2000 hp to 1/500 hp on continuous duty. With speed reducer: Drive-shaft speeds ranging from 300 rpm to 1 rpm and with torque ratings of 1.3 in. oz to 110 in. oz, respectively. The Type K motor (which is 23/8" high) is especially adapted to use on instruments and timing devices.



### TYPE U MOTOR

Available in 1/20 and 1/15 hp, at 1725 rpm, and 1/30 hp, at 1725 rpm, and 1/30 hp, at 1125 rpm. Diameter 43/6". Split-phase construction. Resilient mounting for quiet operation. Thermal overload protection. For use in office machines, automatic phonographs, circulating pumps, air-conditioning equipment. Available only in standard construction and on quantity orders. Attractively priced. Rapid delivery on all orders.



### SERIES WOUND MOTOR PARTS

SET includes: Field core and coil assembly, armature, brushes and associated parts, and fan. SIZE: Diameters to 3½". Wound to order for all fractional horsepower ratings. APPLICATION: Portable power tools and appliances.

#### REDUCER

### MOTORS





Group 3: Single-reduction, wormgear reducer, designed for transmitting moderate torques. Height, 41/6".



Group 2: Designed to deliver moderate torques. Height, 43/4".



Group 1: Designed to transmit low torques. Height, 35%".

### BODINE FRACTIONAL HORSEPOWER MOTORS

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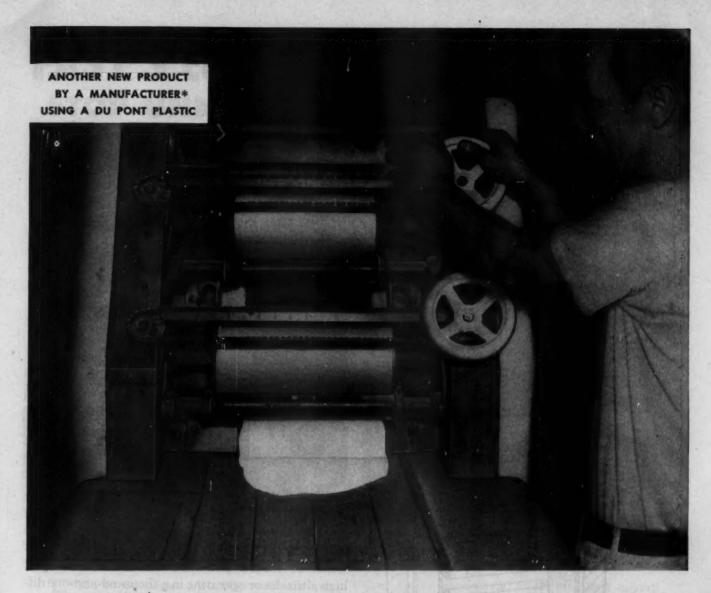
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### "TEFLON" ROLLS DOUGH WITHOUT STICKING-SAVES UP TO \$20 A DAY PER MACHINE



WHAT'S NEW. The faces of this new home heat-sealer for frozen food packages are covered with a tough, thin film of highly heat-resistant Du Pont "Teflon." It makes home packaging easier because the "Teflon" cover prevents sticking of the faces on the sealer to plastic films used in home packaging of frozen foods. Made by The Dobeckmun Company, Cleveland, Ohio.

Nothing sticks to Du Pont "Teflon" tetrafluoroethylene resin . . . not even sticky dough. That's why bakers use bread sheeting rolls covered with a ½-inch layer of "Teflon." Unlike other types, these rolls don't pick up doughneed no flour dusting or scraping. Bakeries save as much as \$20 a day on a single machine by the elimination of dusting flour alone.

In addition, rolls covered with "Teflon" yield a thinner sheet than oldstyle steel rolls, yet won't tear the dough . . . give a smooth, uniform

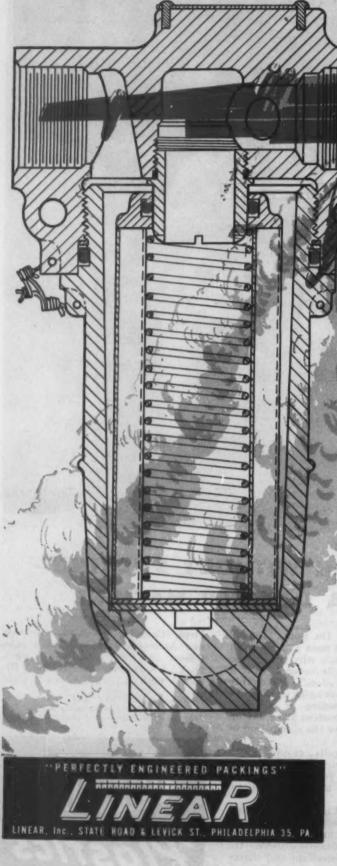
product.

"Teflon" is used in many operations involving the handling of sticky materials. But this is just one of its many types of uses. It's flexible, durable—the most highly heat-resistant and chemically inert of all commercial thermoplastics. It's supplied as sheets, rods, tubes, tape, and molding powder. Write for more data on "Teflon" and other Du Pont plastics. E. I. du Pont de Nemours & Co. (Inc.), Polychemicals

Dept. (Consolidation of Plastics Dept. and Ammonia Dept.), Plastics Sales Offices: 350 Fifth Ave., New York 1, N. Y.; 7 S. Dearborn St., Chicago, Ill.; 845 E. 60th St., Los Angeles 1, Calif.

\*Rolls covered with "Teflon" used on bread moulder-panner manufactured by Stickelber & Sons, Inc., 1150 Southwest Boulevard, Kansas City, Kansas.





### 1111=15

### "O" RINGS...

### sealing unlimited!

Yes, LINEAR "O" rings give unlimited sealing performance whether installed in aircraft units flying at high altitudes or operating in a thousand-and-one different installations on the ground. After exhaustive tests, Purolator Products determined that LINEAR "O" rings, used in their automotive and aircraft filters, are resilient and tough enough to fully withstand shock and vibration as well as extreme pressures and temperatures.

Purolator's new aircraft hydraulic filter illustrated here uses Linear "O" rings to resist pressures as high as 4800 p.s.i. and temperatures from as low as minus 68°F. to as high as plus 280°F. Purolator's experience is a good example of the versatility, reliability and simplicity effected with Linear "O" rings.

In addition to a long list of natural or synthetic rubber compounds adaptable to a wide range of temperatures, gases and liquids, LINEAR is successfully moulding "O," "V," "U" or other shapes of Kel-F, Teflon and Silicone for special applications. These special materials are suitable for seals from minus 320°F. to plus 400°F. against concentrated sulfuric, hydrofluoric, hydrochloric and other vigorous oxidizing materials.

For your individual packing design or application, CALL LINEAR.

FAST'S COUPLINGS
STOP UNNECESSARY
SHUTDOWNS IN
Vouz PLANT

Exclusive Metal-to-Metal Seal
And No Perishable Parts Give
Uninterrupted Power Transmission

OIL LINE
FLOATING
SLEEVE

tecting "rocking bearing" allows freedom of movement to compensate for misalignment because spherical base

as hub spline faces.

STEEL MILLS specify Fast's Couplings for equipment of every shaft size to avoid production shutdowns caused by failure of ordinary couplings! This Coupling has been in use since 1923!

**POWER PLANTS** use Fast's Couplings because metal-to-metal seal, absence of perishable parts, virtually eliminate shutdowns!

FAST'S Couplings virtually eliminate plant shutdowns because Fast's exclusive metal-tometal seal gives positive protection, provides uninterrupted power transmission! Complete flexibility to compensate for shaft misalignment is done mechanically. Load-carrying oil is completely guarded by exclusive "rocking bearing" that keeps out dirt, grit and moisture without perishable packing rings! Nothing to wear! Nothing to replace! Result: Uninterrupted power transmission for all your installations!

Fast's complete line of Couplings is available right from stock from distribution points coast-to-coast. All Fast's Couplings are backed by years of top engineering experience, Koppers'high standard of workmanship, and unexcelled coupling service including available parts if required by change of drive, even if your Fast's have been running for 30 years! Fast's installed on your equipment

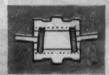
mean longer machine and motor life, lower upkeep costs, minimum shutdown losses. Write today or use the handy coupon and get all the facts in the new Fast's Catalog. Address: Koppers Co., Inc., Fast's Coupling Dept., 352 Scott Street, Baltimore 3, Maryland.

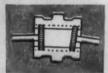
#### Compensate for all Misalignment

The floating sleeve takes a neutral position. All forms of misalignment are compensated for between the lubricated faces of the splines, equally divided between driving and driven members. The entire assembly revolves as one unit.

The exaggerated diagrams below demonstrate this Fast's principle







FAST'S Self-Aligning COUPLINGS



MAIL FREE	CATALOG	COUPON	TODAY!

KOPPERS CO., INC., Fast's Coupling Dept., 352 Scott Street, Baltimore 3, Md.

Please send me your Fast's Goupling catalog No. 47 which contains all the facts and specifications.

Name......Title.....

Company

ORIGINATED WITH UNBRAKO IN
1934

BECAUSE OF THEIR KNURLED HEADS,

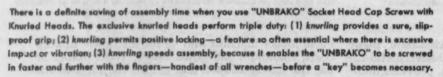


SOCKET HEAD CAP SCREWS

SCREW IN FASTER AND

FURTHER BEFORE A

WRENCH BECOMES NECESSARY



As always, the brand name "UNBRAKO" signifies great strength and precision manufacture to close tolerances. "UNBRAKO" Knurled Socket Head Cap Screws are available in sizes from #4 to 1" diameter, in a full range of lengths. Other sizes to special order. Write for your copy of the "UNBRAKO" Catalog.



SELF-LOCKING
"UNBRAKO"
SOCKET SET SCREW
WITH KHURLED THREADS
PAT'D AND PATS, PEND.



"UNBRAKO" FULLY-FORMED PRESSURE



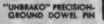
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SET SCREW
WITH KNURLED
CUP POINT
PAT'D



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PAT'D AND
PATS. PEND.



"UNBRAKO"
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WITH KNURLED
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Whether your problem is controlling temperature or pressure, sealing shafts or valves against leakage, or transmitting motion, it may pay you to investigate bellows assemblies. Doing it before your designs are too far advanced may save you time, trouble and money. Our engineering department will make a confidential analysis of your sketches and specifications and submit recommendations. No cost or obligation involved. CLIFFORD MANUFACTURING COMPANY, 124 Grove St., Waltham 54, Massachusetts. Division of Standard-Thomson Corporation. Offices in New York, Detroit, Chicago, Los Angeles.





HYDRAULICALLY - FORMED BELLOWS

FOR AIRCRAFT ENGINES



















Amouncing:

Composition Sealed Bearings COMPOSITION SEAL
(OIL RESISTANT SYNTHETIC
RUBBER COATED FABRIC)

SERIES 1600 AND 3000, COMPOSITION SEALED.

## NICE

Exhaustively field tested and proven highly successful, the NICE composition seal design effectively retains lubricant and excludes foreign material. Thus, NICE has added the performance advantage of an efficient seal to the already basic advantage of a quality bearing at comparative low cost.

Write for New Catalog No. 140



NICE BALL BEARING COMPANY



### NO PLACE FOR REPLACEMENTS HERE!

. so the nation's biggest underwater tunnel uses Everdur† Electrical Conduit to carry traffic light and control cables. New York's Triborough Bridge and Tunnel Authority, builders of the Brooklyn-Battery Tunnel, made selection on the basis of long-time service records on comparable installations.

### WELL, WELL, WELL, WELL

That's right, four of 'em. 38" diameter slotted well screens of Everdur, built by the Layne-Northern Company of Mishawaka for Elkhart, Indiana's water supply. Reasons: strength, weldability, machinability, trace of rust!



### Watching EVERD



### TRAFFIC

Down from the Alvarado Regulating Reservoir rushes the water supply for San Diego at 100-lb. pressure. Many of the vital parts of these mechanical traffic cops are made of Everdur for long operating life. These big butterfly valves, up to 42" I. D., were made by Coldwell-Wilcox Division of Krajewski-Pesant, New York.

HAPPY THOUGHT IN A SQUAL

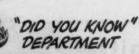
When thunderheads race up and your boat lays over on her beam's end - you pray everything will hang together. That's the time to be thankful for your boat builder's judgment in using strong, tough, non-rust Everdur fastenings

... and speaking of seagoing metals, the Design Engineering Company of South Pasadena, California, developed this marine shell block of Everdur. Maximum strength and minimum weight are combined in this one-piece, folded-and-drawn, rivetless block construction.

### P.S. HOW ABOUT SENDING IN YOUR STORY ON EVERDUR?

Where corrosion resistance counts ANACONDA

COPPER-SILICON ALLOYS\*



Maybe it never occurred to you that many belt-drive applications require a nonmagnetic, spark-resistant lacing. Well, they do. And the Flexible Steel Lacing Company of Chicago makes 'em under the trade name "Alligator." Out of Everdur, of course.

### WHAT'S YOUR METAL PROBLEM?

Maybe Everdur can help. Our Technical Department is always ready to serve. Just write to The American Brass Company, Waterbury 88, Connecticut. In Canada: Anaconda American Brass Ltd., New Toronto, Ontario.

# How to equip your machines for Accurate and Positive Variable Speed Control

### —and speed up your machine sales

Increased output, even as much as 25%, so frequently obtained with Reeves Speed Control, is not all that new machine buyers are looking for. Higher quality of production, fewer rejects, and less waste of labor and materials, make a similar contribution to lower production costs.

All of which calls for more than mere speed adjustability. It calls for accurate, positive, non-fluctuating power transmission, at the best speed for every job. It calls for infinitely variable speed regulation that will not budge from its setting, regardless of speed or load—the variable speed control that is attained with the non-slipping, wedge-like action of the rugged Reeves endless cord V-belt, that provides dependably controlled tension at all driving speeds.

When machine speeds can be adjusted, instantly and positively, without stopping the machine, as with Reeves Speed Control, the operator can fit the speed to the job, to any change in operating conditions, to the kind, quality or condition of material, to his own skill and efficiency. Thus, highest possible quality and quantity of production are maintained, with minimum waste of time and material. The machine sells easier because it does more work, better work, at lower cost.

Why not investigate the advantages of REEVES Speed Control, for your machines today? The wide range of sizes of three (not one) basic units in the complete REEVES line simplifies the installation, insures the correct unit for the job, and keeps the cost for standard equipment at the lowest possible figure. There's a REEVES representative, a member of our nation-wide staff of speed control engineers, in your city or vicinity. He will be glad to discuss all of these details with you, at your convenience, and entirely without obligation on your part. Send for new catalog No. H26-3N, just off the press.

### The Three Basic Reeves Units



VARIABLE SPEED TRANS-MISSION for providing Infinite, accurate speed flexibility over a wide range—2:1 to 16:1. Sixes —fractional to 87 hp.



VARI-SPEED MOTOR PUL-LEY provides an instantly variable speed drive within 4:1 ratio for any constant speed motor. Sizes to 10 hp.



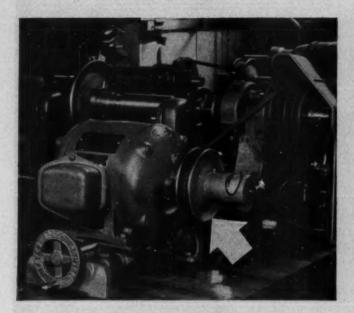
MOTODRIVE combines motor, speed varying mechanism and reduction gears in single unit. Speed variations 2:1 to 6:1 inclusive. Sizes to 20 hp.

### And Now a "Junior" REEVES for Lightest Machines

The latest member of the REEVES "family" of variable speed control units. Simplified, low cost unit is ideal for light duty lathes, saws, grinders, drill presses, pumps, etc. Forms actual driving element between motor and driven machine. Provides the right speed for every operation. Covers the entire speed range

smoothly, without jumps or steps, without stopping the machine. Easy to apply—easy to use—uses any standard constant speed motor, any standard V-belt. Ask for Bulletin V-4912.

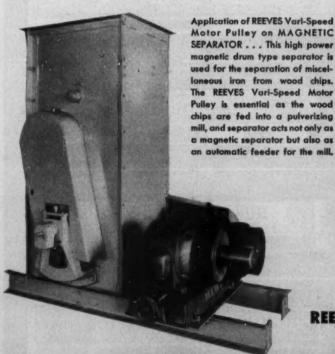




Application of new Vari-Speed Jr. unit on a dynamic balancing machine. In this particular instance the Vari-Speed unit replaced a step-cone pulley so that by simply turning the handwheel, without stopping the machine, the driving speed can be quickly changed to compensate for different sizes and weights of pieces tested. Also, through the use of this variable speed drive, the operator can check the pieces being tested under all speeds that the piece might encounter in actual operation.



Application of REEVES Variable Speed Transmission on a Heavy Duty Turning Roll. These machines are used for rotating extremely large and heavy vessels, for manual or automatic welding. Size of vessel determines rotating speed, accurately controlled with the REEVES Transmission. Unit shown is a No. O-B REEVES giving an 8:1 speed variation and operating speed ranging from 5" to 40" per minute.



REEVES Motodrive with 5 H.P. explosion proof motor connected directly to a worm gear reducer to drive agitator at a speed between 26 and 130 rpm. This unit is a 500-gallon jacketed stainless steel kettle for use in preparation of penicillin.

REEVES PULLEY COMPANY . COLUMBUS, INDIANA

Reeves Speed Control

GIVES THE RIGHT SPEED FOR EVERY JOB!

Recognized Leader in the Specialized Field of Speed Control Engineering

### 8 outstanding N.B.M. BABBITTS

Help Give You Better Bearing Performance . . . Longer Bearing Life

Good babbitt is the result of using Virgin Metals, correctly proportioned and blended under close laboratory control. You find all these qualities in N-B-M Babbitts.

The 8 N-B-M Babbitt Metals shown are the result of years of research combined with actual engineering analysis of all types of bearing lining problems. Each of these N-B-M Babbitt Metals is "custom-alloyed" for specific types of service conditions. Thus, each has definite advantages overso-called "all-purpose" babbitts—advantages that result in longer, more economical bearing service.

These "Custom-Alloyed" bearing lining metals have effected important savings in plant maintenance—and big improvements in product performance. Every Product Designer or Plant Engineer should have engineering data on the complete line of these better N-B-M Babbitt Metals.

N-B-M Bubbitt Metals...
This folder describes all 8 N-B-M Bubbitt
Metals giving data on

Metals, giving data on application, physical properties, preparation of bearing shells and pouring.

Write for your free copy!



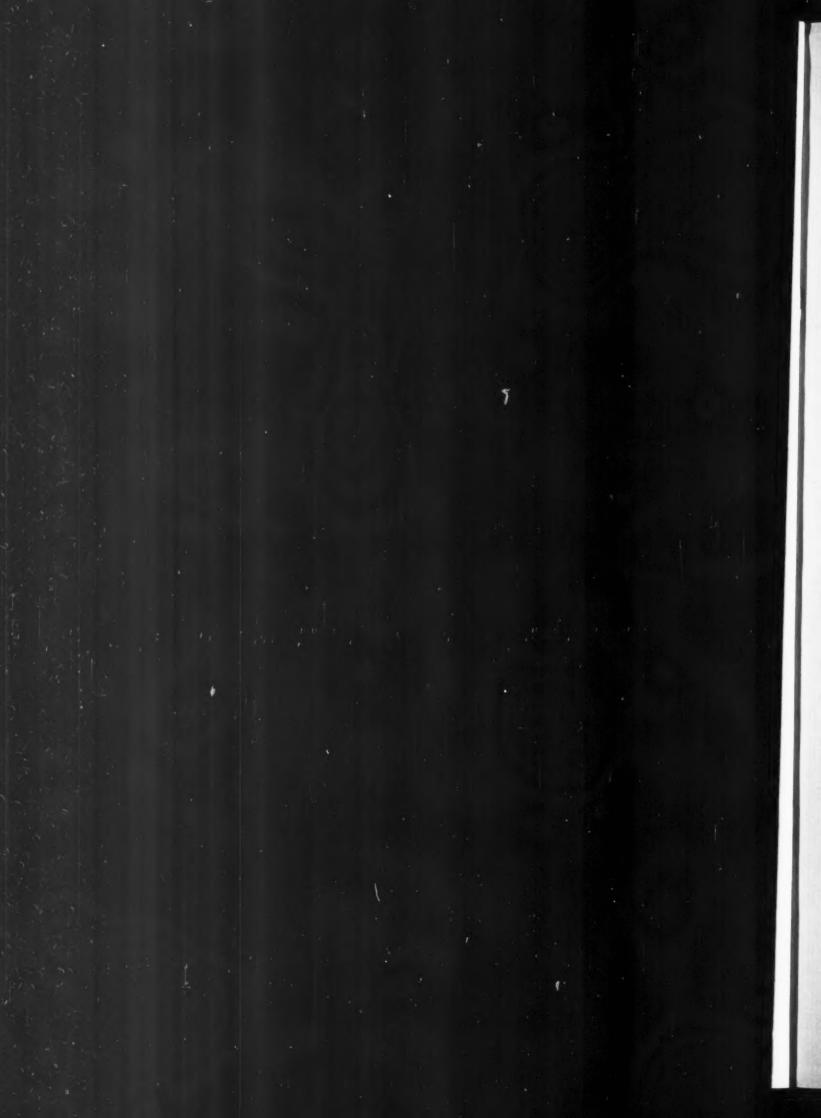
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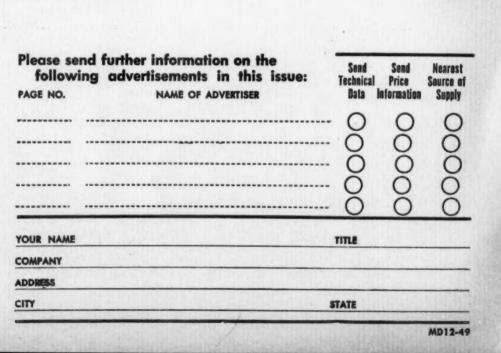
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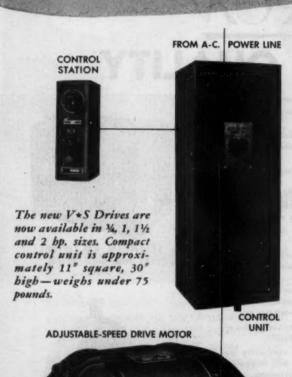




## NOW... NEW V\*S DRIVES

(3/4-2 hp.)

for Thousands of Additional Applications



The Original Packaged All-Electric,

Adjustable-Speed Drive for A-c. Circuits

## at a price everybody can afford!

## Adjustable Speeds from A-c. Power for GREATER PRODUCTION at LOWER COST!

Here is a simple, space-saving, low-cost All-electric Adjustable-speed Drive. This V\*S Drive utilizes the same fundamental principles employed in the design of all Reliance V\*S Drives for over 11 years.

UNLIMITED SPEED CHANGES. Provides an unlimited selection of speeds over a wide range—electrically.

JOGGING AND CREEPING SPEEDS. Selector switch provides for slow, jogging speed. Creeping speeds available through speed adjustor.

REMOTE CONTROL. Push a button and twist a knob—at the machine or at any remote location—for instant action.

QUICK, SMOOTH STARTING AND STOPPING. Offers fully controlled starting and stopping. Dynamic braking is available.

SPACE-SAVING. Compact, adjustable-speed drive motor connected to the driven machine saves valuable production space.

SIMPLIFIED DESIGN. Simplest design ever achieved in a packaged, all-electric adjustable-speed drive operating from A-c. circuits.

ADAPTABLE. The new V\*S Drive can be easily applied to existing machines or built into machines as original equipment.

Machine builder or machine user, it will pay you to have all the facts on this important extension of the V\*S line. Write today for Bulletin D-2101.

Sales Representatives in Principal Cities

### RELIANCE ELECTRIC AND ENGINEERING CO.

"Motor-Drive is More Than Power" . 1079 in the Basel Clavatend 10, Ohin



BIN VIBRATORS Make Stubborn Materials Flow Freely



VIBRATORY FEEDERS Finger-Tip Control of the Rate of Bulk Material Flow



VIBRATORY PACKERS
Pack and Settle Materials
in Containers and Molds

### **USE COMPONENTS** NTRON

#### DEPENDABLE QUALITY



Single Line Food - Piece by Piece

ELECTRIC VIBRATORS, promoting free-flowing materials out of bins, hoppers and chutes.

VIBRATORY FEEDERS, controlling the flow of materials in packaging machines, batching

VIBRATORY PACKERS, settling materials in containers and in molds.

SMALL PARTS FEEDERS, feeding small objects to automatic machinery, inspection belts, counting and packaging machinery.

VIBRATING GRIZZLIES, for rough scalping and separation.

VIBRATING SCREENS, removing foreign objects, lumps, etc., from foods, chemicals,

SHAFT SEALS to eliminate leakage of gases and liquids from around rotating shafts of compressors, pumps, mixers, etc.

SCREW PUMPS, handling various grades of oil-crude, fuel, lube and hydraulic.

HOPPER LEVER SWITCHES, controlling the amount of material in bins and hopperscontrolling batch weighing by volume.

SELENIUM RECTIFIERS for efficent conversion of A.C. to D.C. in all types of electrical equipment. From 1" sq. plates up to 6" 12".

Write for catalog data

SYNTRON CO. 260 Lexington, Homer City, Pa.





HOPPER LEVEL SWITCHES
Control Maximum and
Minimum Hopper Contents



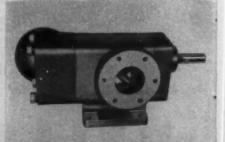
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VIBRATING GRIZZLIES

Both Feed and Scalp With One Unit

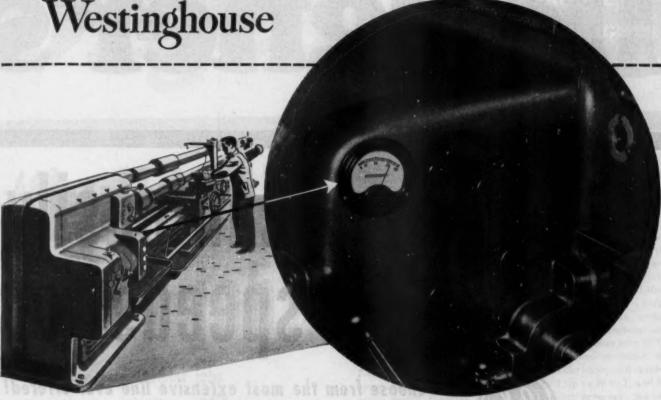


SHAFT SEALS Replace Packing and Eliminate Leakage From Around Rotating Shafts



SCREW PUMPS or Smooth, Pulseless entinuous Axial Flow

YOU CAN BE SURE .. IF IT'S Westinghouse



### This Westinghouse Instrument helps set New Production Records

Savings in machine time up to 75% are common among the users of the American Tool Works Company's new hydraulic duplicating lathes!

A standard feature of these lathes is the Westinghouse horsepower instrument. It shows, at a glance, the horsepower being consumed by the cut. This enables the operator to take full advantage of the capabilities of the machine and to make maximum cuts without overloading. Machines can be easily operated at peak loads, without the dangers of overtaxed motors and damaged cutting tools.

This is another example of the application of Westinghouse instruments to specific problems. Westinghouse instruments are engineered and built to give you reliable performance in every application. The completeness of the line means electrical measuring instruments to fill your needs exactly in every field of industry.

Westinghouse instrument specialists are available in the field for consultation. Call your nearest Westinghouse office or write Westinghouse Electric Corporation, P. O. Box 868, Pittsburgh 30, Pennsylvania.



ELECTRICAL MEASURING INSTRUMENTS FOR ANY JOB

## Now you can easily the RIGHT speeds for



Choose from the most extensive line ever offered!

PACK AGED DJUSTABLE-SPEED DRIVES



HERE'S HELP IN SELECT-ING THE DRIVES YOU NEED!

You'll find this new 26page illustrated manual a gold mine of helpful information on the whole subject of adjustable speed. It describes the specific ad-

vantages that properly-applied adjustable speed has brought to various industries, and discusses points to be considered by designers in selecting adjustable-speed drives. It's yours for the asking! Send for new Bulletin GEA-5334.

Better control of drive speeds—through electric adjustable speed—is your key to making machines more productive, more versatile, more accurate. Now General Electric makes it easier for you to incorporate in your machines the electric adjustable-speed drives that will match your specific design needs. Here is the most comprehensive line of packaged adjustable-speed drives ever offered by one manufacturer!

All this and packaged too! These G-E adjustable-speed drives—made in pre-engineered "packages"—eliminate costly installation expense and delay. By providing optimum speeds, they enable machines to produce faster, process a greater variety of goods, turn out better and more uniform products with less wasted material. They're easy to operate and maintain, and because of their compactness and flexibility, they use only minimum space, whether "built-in" or mounted adjacent to the machine. This simplifies your customer's plant lay-

out problem.

Just off the press is an all-new series of booklets on G-E adjustable-speed drives. We'll gladly send you copies. Apparatus Dept., General Electric Co., Schenectady 5, N. Y.



GENERAL



ELECTRIC

## Digest Ge PRODUCT HIGHLIGHTS

# "build-in" every job!

#### RIGHT for your simpler jobs

Need adjustable speed with moderate regulation over a moderate speed range? The simplest, least expensive way to get it is with the General Electric Type ACA motor plus standard control. A simple twist of a dial gives you stepless speed adjustment over ranges from 3 to 1 up to 20



to 1. A compact motor, it's built to standard NEMA dimensions to simplify installation. Ratings, in Tri-Clad construction, run from 3 to 75 hp. See sew Bulletin GEA-4883.

#### RIGHT for your intermediate needs



For speed ranges up to 16 to 1 or more with good regulation and great flexibility, turn to the General Electric Speed Variator. It's mass-produced for price economy, yet built to meet your specific needs. Components are a d-c driving motor located at your machine, an operator's control station that can be put in any convenient loca-

tion, and a "package" containing everything else—motor-generator set, exciter, and all control. This "package" can be either mounted directly on the machine or located remotely to save space at the machine. See sew Bulletin GEA-3335.

### RIGHT for precision speed control in the higher hp ranges



speed drive to operate in the 15 to 60 hp range, the economical choice is the General Electric Electronic Speed Variator. An electronic control system replaces the exciter and adds the precision and versatility of electronics to the

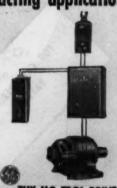
If your machine requires a closely-regulated adjustable-

SPEED VARIATOR

continuing economy and reliability of a motor-generator set. Excellent speed regulation, controlled acceleration, and stepless speed adjustment over ranges from 8 to 1 up to 50 to 1, and beyond, permit machine speeds of pin-point accuracy. See new Bulletin GEA-5336.

#### RIGHT for your most exacting applications

Most accurate, most versatile and fastest-acting of all General Electric packaged adjustable-speed drives is Thy-mo-trol®. This allelectronic system, in standard ratings from 1/40 to 30 hp, provides amooth, stepless speed control over ranges up to 100 to 1 and even beyond—can hold any set speed within ½ per cent or less regardless of changes in load or line voltage—offers almost endless combinations of standard and optional features for practically any application. See new Bulletin GEA-5337.



THY-MO-TROL DRIVE

Apparatu	Department, Schenectady S, N. Y.
	nd me the following bulleting
	-4883—ACA motors -5334—Adjustable-speed drives
	-5335—Speed veriator
The second secon	-5336 Electronic speed variator
	-5337—Thy-mo-trol drive
the same of the same of the same of	YOUR McGRAW-HILL ELECTRICAL CATALOG FOR
PRODUCT	ENGINEERS! You'll find "everything electric" for manufacturers in the General Electric section.
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## ROLLS - "TAGGED" FOR PRACTICALLY ANY APPLICATION

Products of the world's largest specialty roll shop at Ansonia are made for such diverse uses as processing rubber, plastics, linoleum, celluloid, phonograph record blanks, asphalt, asbestos, ink, paint, soap and textiles; calendering paper; rolling metal; grinding flour, coffee and sugar cane; crushing tobacco stems; and extracting oil from linseed and cottonseed.

Here rolls are designed and manufactured in sizes from 5" to 72" in diameter and up to 35 feet long overall, of chilled iron, alloy iron, gray iron, Meehanite® metal or steel. Highest grade materials are used and every manufacturing step, from metal mixture and casting, to grinding and inspection, is under constant, close control.

a culture of the cult

Farrel-Birmingham





# New safety-New value!

outstanding fractional horsepower manual motor starter

THERE'S A WIDESPREAD NEED for small motor starters . . . and you'll meet it in a big way with the new Noark Protectit. This compact, modern device provides dependable automatic overload protection and is designed

throughout for truly superior service.
The new Noark Protectit has doublebreak silver contacts welded to phos-

phor bronze contact springs. Reset after tripping is automatic. Individual arcing chambers confine each arc and assure rapid extinction. The bimetallic overload element is time-proven and accurate. Overload relay heaters are conveniently mounted from the front of the Protectit with a single screw.

New Noark Protectits are rated in 1

h.p., 115-230 V., single phase A. C., and in % h.p., 115-230 V., D. C. Surface enclosure and open types; flush mounting Protectits using standard flush plate available. Order from your Federal Distributor. And have him send you a descriptive folder. Federal Electric Products Company, 50 Paris Street, Newark 5, New Jersey.



### PROTECTIT

Complete line of Federal Electric Products includes Motor Controls, Safety Switches, Service Equipment, Circuit Breakers, Panelboards, Switchboards, Control Centers, Bus Duct \* Sales Offices in principal cities.



For certified data on individual grades of Stainless Steel, use

#### ALLEGHENY LUDLUM BLUE SHEETS

There is a Blue Sheet for each individual grade of Allegheny Metal, giving full information on its physical and chemical properties and characteristics. Let us send you this certified, laboratory-proved data on the stainless grades in which you are interested.

ADDRESS DEPT. MD-82 For any job you may have which involves the handling of large volumes, heat and high pressures—either singly or all at one time—you can get Allegheny Metal solid or clad plates in the exact stainless grade you need to combat corrosion, oxidation and contamination.

Some of these grades are new... comparatively recent developments of our research and experience as a pioneer and leader in stainless steel production. Others are improved versions of older analyses. The latest information on the entire subject of stainless plates is available to you in the booklet illustrated above—32 pages of valuable data on types, sizes, finishes, fabricating methods and uses, including ASTM and ASME boiler codes.

Specify "Allegheny Metal" for

complete reliability in stainless steel plates, and write for your copy of the A-L Plate Book.

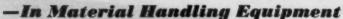


Nation's Leading Producer of Stainless Steels in All Forms



WAD 2556

ALLEGHENY METAL is stocked by all Joseph T. Ryerson & Son, Inc. warehouses

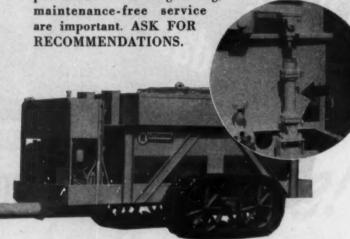


- -In Construction Machinery
- -In Machine Tools

Headline" Performance!

This 7½ ton Ross lift truck literally "stole the show" at the 1949 Shriner's Convenn in Chicago. Hunnifin equip

IT'S a better product when it's Hannifin equipped! Hannifin Hydraulic Cylinders are unexcelled for precision construction, precision performance. An improved type of high pressure cylinder, they are built especially to meet the requirements of makers of finest machine tools. Yet they are equally economical and practical for all kinds of applications where smooth, full-power performance and long-lasting,



while you "run"! The agitator in this botch trailer built by Littleford Bros., ti, Ohio, is operated by a Hannifin hydraulic cylinder to keep the mix from

oork of TEN" describes this special Hannifin equipped 10 built by The Ingersoll Milling Machine Co., Rockford, Ill.

## HANNIFIN Hydraulic

IMPROVED DESIGN. Universal end caps for easy installation and simplified piping. Full 4-ring piston construction; tight-sealing, honed, precision type. No tie rod design.

"TRU-BORED" AND HONED. Exclusive Hannifin long stroke honing process; satin finish. All parts interchangeable.

TYPES FOR EVERY PURPOSE. 12 standard bore diameters, 1" to 8". Any length stroke. 11 standard mounting styles. With or without cushions.

**ENGINEERING RECOMMENDATIONS. Backed** by more than forty years of leadership in the field.

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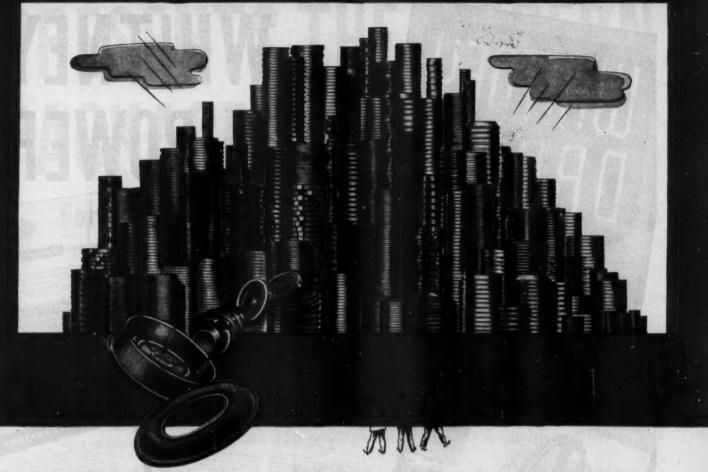
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HANNIFIN AIR CYLINDERS

PNEUMATIC PRESSES

HYDRAULIC CYLINDERS HYDRAULIC RIVETERS Nationwide Sales and Service

HYDRAULIC PRESSES AIR CONTROL VALVES



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Chances are the Sirvene part you order will be utterly unlike any other. For, while Chicago Rawhide produces literally tons of Sirvene in a year's time, every batch is earmarked for a different pliable part. Each of these parts is designed and developed to do just one special job in a particular mechanism. For every application, Sirvene engineers compound a special formula from pure, oil-resistant elastomers. From it, they mold a custom-engineered part which will fulfill specific requirements in tensile strength, elongation, elasticity or hardness, resilience, and resistance to

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Sirvene products include diaphragms, boots, gaskets, oil seals, washers, packings, and other special molded mechanical pliables

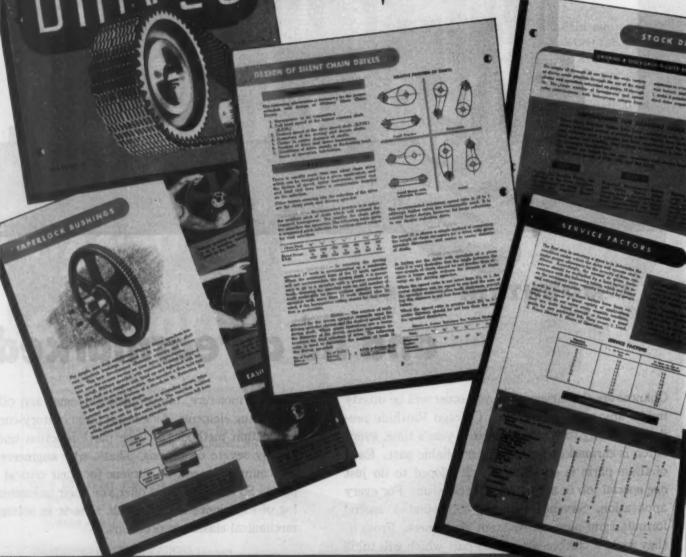
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**ENGINEERS:** For basic information, write for your copy of "Engineering with Sirvene." There is no charge.

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THE SCIENTIFIC COMPOUNDED ELASTOMER

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Y CHAIN & MFG. CO.

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# PRESENTS THE MODERN PACKAGE FROM STOCK...

#### For Economical, Efficient Power Transmission!

If your drive requirements fall within the range of fractional H.P. to well over 50 H.P. you will want to know more about these new Whitney Silent Chain Drives from Stock. Here's a versatile power transmission medium that gives you thrifty, positive drive performance under all operating conditions! These dependable, all-steel drives deliver constant power from driver to driven mechanism, maintaining full machine output. They are easily installed and give exceptionally long life with minimum maintenance.

This modern power package is quickly available to you from stock through the Whitney fac-

tory and a network of Whitney distributors established throughout the country. And, important, they are easy to select and order, too. By simply referring to the Stock Drive Selection Tables in the catalog, you will find that ordering or specifying a complete stock drive is a time-saving process. Using these exclusive Whitney Tables requires no specialized chain knowledge—completely eliminates tedious calculations usually required in determining power transmission requirements. With dependable Whitney Silent Chain Drives so easily obtainable, you will find that "It pays to standardize on Whitney."

Quick Selection of Correct Silent Chain Drive

Made in 3 Easy Steps

Apply "Service Factor" to drive condition and obtain required Horsepower Rating!

Refer to "Selection Table" meeting Horsepower Rating and Driver Speed! 3

Under "Driven Speed" find nearest R.P.M. to driven speed required; table gives complete specifications and "Stock Drive No." of the chain drive!

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#### WHITNEY CHAIN & MFG. CO.

Division of Whitney-Hanson Industries Inc. 205 Hamilton Street, Hartford 2, Conn.

Gentlemen

Please send me your new silent chain stock drive catalog.

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Company

Street ..... City & State .....



"...The only seal we've found that POSITIVELY SEALS a vertical head of tough gear case oil."

Bodine Electric Co.

That's why Bodine Electric Company engineers chose the Gits Unit Seal for the Bodine "Group 4" worm gear reducer (shown here). Gits engineers then applied the Unit Seal without causing any redesign of the reducer.

Gits Seals can solve your shaft sealing problems, too—effectively and economically. Send us your shaft sealing problems on any type of equipment, for prompt recommendations (no obligation).



for informative, detailed booklet on the Gits line of shaft seals complete with diagrams and illustrations of various applications.

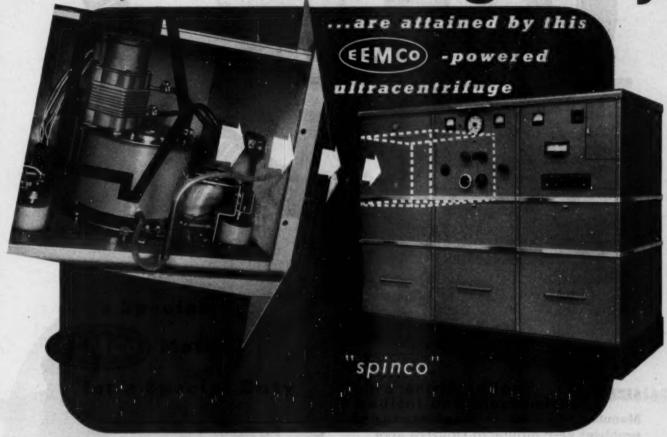
GITS BROS. MFG. Co.

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\* Note the Gits "Style FG" Oil Gauge and the Gits "Style KV" Oil Cup. Gits oils it, seals it, gauges it!

Centrifugal forces over

250,000 times gravity



The terrific centrifugal forces, precision control, and utmost dependability required in operation of

this fine laboratory device dictated special motor requirements. *EEMCO* engineers developed this special motor application to provide a powerful precision-speed-controlled electric drive capable of hundreds of hours of high speed operation without attention. The 1-1/2 hp motor operates on 110-volt current, AC or DC, at 12,000 rpm. It is both air and water cooled.

The manufacturers of the "Spinco" Ultracentrifuge, Specialized Instruments Corporation, Belmont, Calif., called on EEMCO for services typical of special motor development and manufacture performed by EEMCO for leading companies in diverse lines throughout the nation. EEMCO has solved the

widely varying electric drive problems of manufacturers of ultrasonic sound generators, oil well recovery tools, power saws, radar equipment, submersible pumping units, aircraft, and dairy homogenizers.

EEMCO-designed motors and drive units have solved the very toughest problems of function, power, size, weight, shape, performance, installation and operation.

Perhaps you need a completely special design...or we may be able to adapt a basic *EEMCO* design to meet your needs. Let *EEMCO* tackle your motor problem.



ELECTRICAL ENGINEERING and MFG. CORP.





SPECIAL MOTOR DESIGN



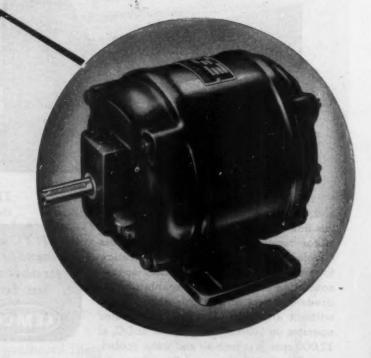


# OLTZER MOTORS FOR DEWANDING APPLICATION

DEPENDABLE

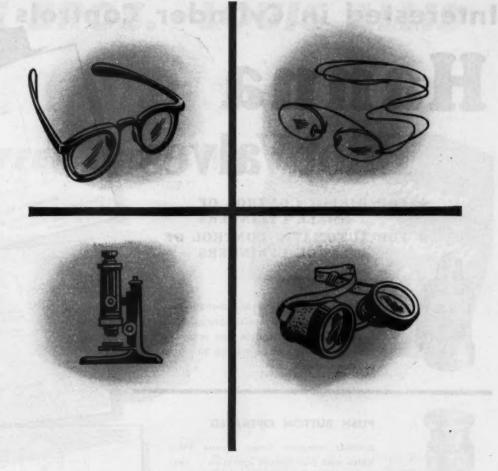
#### SIZES UP TO ONE HORSEPOWER

Manufacturers with motor application problems keep turning to Holtzer-Cabot -and they get the answers! Continuous duty motors . . . synchronous or induction, split phase or capacitor start . . . Holtzer-Cabot motors are available in a variety of types from the small instrument sizes up to heavy duty one horsepower units. Here are motors built for exacting requirements. In applications such as office and recording machinery, blower units, hoists, machine tools, fans, pumps and farm equipment, Holtzer-Cabot precision made motors have been proven in use by world famous manufacturers. Write or phone today for complete information.



BUILDERS OF FINE ELECTRIC MOTORS FOR THREE-QUARTERS OF A CENTURY

HOLFZER-CABOT DIVISION OF NATIONAL PNEUMATIC CO., INC.



#### A TEAM OF EYES FOR BETTER STEEL CASTINGS



Knowing eyes, trained by long experience contribute to each step in the careful process of making Sivyer steel castings. The executive, the metallurgist, the foundryman, the grinder, even the salesman . . . all project and combine the resources of their individual skills and knowledge into a smoothly working team. Their goal...the production of the finest in high alloy castings.

SIVYER STEEL CASTING COMPANY . MILWAUKEE S CHICAGO S



Interested in Cylinder Controls ...

## Hanna Pilot Valves

\* FOR DIRECT CONTROL OF SMALL CYLINDERS

★ FOR AUTOMATIC CONTROL OF LARGE CYLINDERS



#### CAM OPERATED

Ideal for automatic or semi-automatic control . . . A 3-way valve with spring-loaded roller actuated by straight line or rotary cam . . . Roller can be rotated 90° from position shown.



#### PUSH BUTTON OPERATED

Another compact 3-way Hanna Pilot Valve with push-button operation . . . excellent for control of panel operations—or where guards are used around valve to prevent accidental operation.



#### LEVER OPERATED

For manual control on fast, repeating and continuous operations . . . Efficiently used in circuits where safety is a factor . . . Lever can be rotated 90° . . . Cam, pushbutton and lever-operated valves all have optional brackets for side mounting.



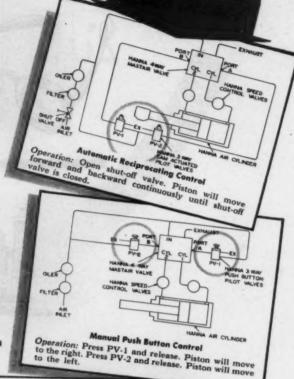


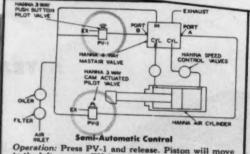
Hanna 4-way Foot-operated Pilot Valves are available in single and double-pedal units for convenient, hand-free control of cylinders. The single-pedal valve is shown.

#### MASTAIR

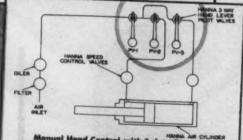


Hanna 4-way Masteir Valve
. . . A balanced spool type
valve controlled by one 4way or two 3-way pilot
valves for automatic control
of large cylinders.





Operation: Press PV-1 and release. Piston will move to the left, contact PV-2 and return.



Manual Hand Control with Safety Festure
Operation: Press and hold down PV-1 and PV-2 and
piston will move to the right. Press and hold down
PV-1 and PV-3 and piston will move to the left.
Purpose of PV-1 is to tie down both hands for safety.

#### Send for Catalog

New Hanna Valve Catalog No. 251 has illustrations, specifications and full details on the complete Hanna Valve line.



M



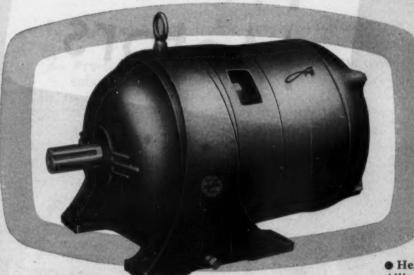
Hanna Engineering Works

HYDRAULIC AND PNEUMATIC EQUIPMENT . . . CYLINDERS . . . VALVES . . . RIVETERS

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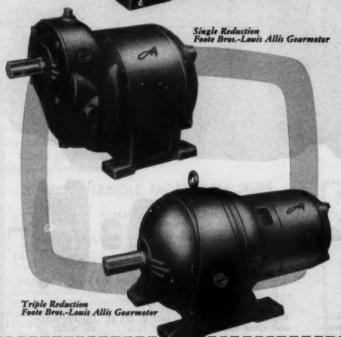
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OFFER INDUSTRY





Double Reduction
Foote Bres.-Louis Allis Gearmotor



• Here is the new line of Foote Bros.-Louis Allis Gearmotors—modern in design, compact, efficient. Engineered to offer the maximum in performance—in year-in, year-out service—in minimum maintenance.

The units are powered by Louis Allis motors famous for quality for three generations.

A wide range of sizes and ratios is available in single, double and triple reductions in ratings of 1 h.p. through 75 h.p. with open dripproof, enclosed, splashproof and explosionproof motors.

These compact drives are engineered to occupy a minimum space, and the husky shafts and bearings permit large overhung load capacities.

Housings are sturdy castings—streamlined inside and out—and are designed for proper lubrication of gears and bearings.

Hardened helical gears are of highest quality. Extreme precision assures long, satisfactory service and quiet operation.

See your Foote Bros. representative or mail the coupon for information.

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Better Power Transmission Through Better Dears

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Please send me information on Poote Bros.-Louis Allis Gearmotors.

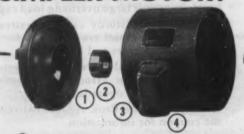
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## Flange Motors

## EVER SEE A SIMPLER MOTOR?



① Steel guard directs air stream toward stator windings for efficient cooling. ② Pre-lubricated ball bearings are simple press fit on motor shaft, they require no further lubrication for years. ③ Rigid, cast iron frame completely surrounds and protects stator core. ④ Diagonally-split conduit box is adjustable to any

angle is roomy easy to get at. (2) Pressures

angle... is roomy... easy to get at. ③ Pressure-cast rotor has integrally cast fans... no welds or rivets... there's nothing to rattle or shake loose. ④ Balanced ventilating fan is keyed to rotor shaft... produces strong blast of cooling air. ⑦ Flange is counterbored for oil seal... has protecting mesh screens.

Sold — Applied — Serviced by Authorized Dealers, Certified Service Shops, and District Offices Throughout U. S.

ALLIS

# GIVE YOUR 4-Point Motor Protection

- 1. Rigid cast iron frame completely surrounds all working parts . . . resists corrosion!
- 2. Pre-lubricated bearings eliminate bearing maintenance . . . require no further lubrication for years.
- 3. Double-insulation gives extra protection against heat, moisture, and corrosion.
- 4. Pressure-cast rotor has no rivets or welds . . . is indestructible in normal service.

Available in three flange types... sizes to 150 hp in open, enclosed and protected types, with electrical and mechanical modifications to suit specific requirements.

HERE'S A LINE OF FLANGE MOTORS you can design into your products and forget! Notice how compact these motors are . . . how trim in appearance. Further, their large, roomy conduit boxes and clearly marked connections make them easy to install.

Notice how the outer frame completely protects all working parts. This feature combined with pre-lubricated bearings and pressure cast rotors adds up to "allaround" protection against distortion, corrosion, friction and entrance of foreign matter. And bell housing is drip-proof, at no extra cost!

is drip-proof, at no extra cost!

Best of all, these Allis-Chalmers motors are backed by a long-established record for building as tough and sturdy a line of motors as you can find anywhere on the motor market.

Check your needs in the coupon below for additional information.

#### 3 TYPES HANDLE MOST OEM JOBS



C FLANGE TYPE — Generally used for close coupling to pumps. Employs rabbet fit with mounting holes on smaller diameter than rabbet fit. Holes tapped for mounting bolts.

D FLANGE TYPE — For machine tool applications. Uses rabbet fit with mounting holes on larger diameter than rabbet. Holes are clearance holes with bolts usually assembled from motor side.





P BASE TYPE — Generally used for vertical applications. Employs rabbet fit with mounting holes on larger diameter than rabbet. Holes are clearance holes.

Texrope is an Allis-Chalmers trademark.

#### AMERICAN BLOWER GYROL FLUID DRIVES USE ALLIS-CHALMERS MOTORS

New Type TM Gyrol Fluid Drives offer benefits of low starting current, smooth acceleration and shock absorption in the 1 to 20 hp range.



These packaged power drives use Allis-Chalmers constant speed acflange motors to produce a smooth start. The motors come up to 85% of full speed before assuming load. Acceleration is gradual and there is a 50% saving in the amount of current consumed for starting. This

unit makes overmotoring unnecessary and eliminates shocks to machinery. Overload protection is positive and can be adjusted by changing oil level in the unit. For additional information contact American Blower Corporation, Detroit 2, Michigan.

#### Check This Coupon

ALLIS-CHALMERS, 1001A SO. 70 ST. MILWAUKEE, WIS.

Please send me:

- ☐ Flange Motor Specification Sheet (5157324).
- ☐ Handy Guide to Electric Meters (5186052).
- ☐ General Purpose Motor Centrels (1487132).
- Equipment for Machine Teols (2587110) (Centains Information for OEM users on Motors, Texrope drives, Motor Centrols, Coolant Pumps.

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A-2876

CHALMERS





## 4 REELS OF VEELOS replace 316 SIZES OF ENDLESS V-BELTS



Write for your VEELOS
Data Book...it's free and
it's full of engineering, measuring and installation information on Veelos. Everyone
interested in power transmission should have a copy for
ready reference.

MANHEIM MANUFACTURING & BELTING CO. MANHEIM, PENNSYLVANIA



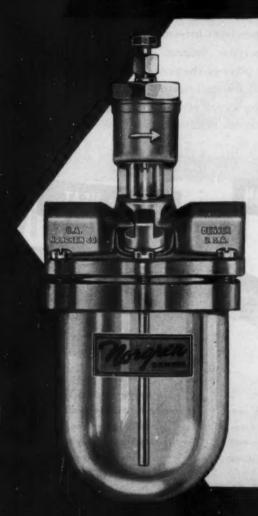
I DON'T like to tie-up operating capital . . . who does? That's why, in our plant, we use Veelos on all v-belt drives. In the old days our stockroom was a dangling mess of endless v-belts. But no more. Now, on wall space only sixteen inches square, hang 4 reels of Veelos. Those 4 reels in O, A, B and C widths take care of all our v-belt needs. Simple story sure, but a sound, practical picture of saving money the Veelos way."

And there are other advantages beyond the saving of inventory when you standardize on Veelos, the adjustable v-belt. Veelos is easy to install—just measure and couple. You never dismantle outboard bearings to replace Veelos v-belts—that keeps machine downtime at rock bottom. Uniform operating tension, smooth, vibrationless power delivery and long life are more plus values from Veelos.

ADJUSTABLE TO ANY LENGTH . ADAPTABLE TO ANY DRIVE

Veelos is made in all standard sizes; fits all standard v-belt grooves. Packaged on reels in 100-foot lengths. Sales engineers in principal cities; over 350 distributors throughout the country. Veelos is known as VEELINK outside the United States.

## An engineering answer to Engineers' search for...



#### **BETTER PERFORMANCE**

from the air-powered equipment they design!

NORGREN AIRLINE LUBRICATORS are essential to the continued peak performance of every machine tool, hand tool, or other equipment operated wholly or in part by air. They are not a mere accessory—but should be an integral part of the air equipment you design.

Norgren Lubricators inject the correct amount of oil into the air that operates the tool or equipment. They create an air-oil fog that coats every moving part with a protective film. Check wear in use, stop corrosion when idle.

Fully automatic—lubricate only when the equipment operates—nothing to turn on or off. Visible oil feed. Needle valve adjustment for accurate flow requirements. Compact and attractive. Add an important sales point to your products.

Complete details . . . C. A. Norgren Co., 222 Santa Fe Drive, Denver 9, Colorado.

Proved by 20 years' service!

Norgren

Lubricators, Regulators, Filters, Valves, other Air Controls, Hose Assemblies

### Super-Alloys in Intricate Shapes

## with HAYNES Precision Castings

HAYNES precision investment castings are available in a range of alloys that are best suited to combat wear, heat, and chemical corrosion. These alloys—such as HAYNES STELLITE, HASTELLOY, MULTIMET, and various stainless steels—are often difficult and costly to machine, forge, or form into the desired shapes. They can, however, be precision investment-cast readily and economically.

If you're having trouble obtaining parts to meet severe operating conditions, investigate the precision investment-casting process. It enables you to specify intricate castings in large quantities—at reasonable prices. And parts are cast to such close dimensional tolerances that finishing operations are reduced to a minimum.

Our staff of engineers will help you decide where precision investment-cast parts can be used in your designs. Contact the nearest district office or the general office in Kokomo, Indiana, for engineering assistance. Ask also to receive a copy of the fully illustrated booklet, "Haynes Precision Castings."

#### Resists WEAR



This part, which is used in a fuel control mechanism for gas turbine engines and operates without lubrication, is precision investment-cast of HAYNES STELLTE 98M2 alloy to resist the severe abrasion encountered in operation.

#### Resists CORROSION



Type 316 stainless steel was selected for this float rod driver, used in a control instrument, because it must withstand the action of corrosive solutions.

#### Resists HEAT



The hallow nozzle diaphragm partition for the General Electric J-47 (TG-190) jet engine is made of HAYNES STELUTE alloy No. 21. It must remain strong and corrosion-resistant at elevated temperatures.

## HAYNES

TRADE-MARK

alloys

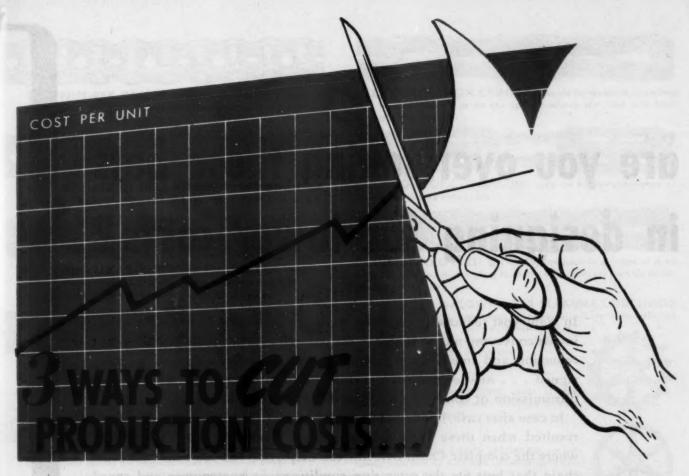
#### Haynes Stellite Company

Unit of Union Carbide and Carbon Corporation

meral Offices and Works, Kokomo, Indiana Sales Offices

Chicogo — Cleveland — Detroit — Housion

The trade-marks "Haynes," "Haynes Stellite," "Hastelloy," and "Multimet" distinguish products of Haynes Stellite Company.



### WITH PERMITE ALUMINUM CASTINGS



A change from heavy metal to lightweight Permite Aluminum Castings can bring you these definite cost cutting savings:

#### I. Save on Cost of Handling

Permite Aluminum Castings are approximately 60% lighter than cast iron and 65% lighter than steel, brass and bronze. They're lighter to handle, lighter to assemble, lighter to ship as a finished product. So you cut handling costs all along the line!

#### 2. Save on Cost of Finishing

The consistent uniformity of Permite Aluminum Castings within close tolerances makes only a minimum of machining necessary. Higher machine speeds and deeper cuts are practical with Permite Aluminum Castings, with only slight changes in tool contours. Time spent per unit in shaper, drill press or milling machine is appreciably less! And aluminum stays bright without painting or expensive plated coatings.

#### 3. Longer Service, Fewer Replacements Mean Long-Range Savings

High tensile strength; resistance to corrosion; rapid heat transfer; and special to-fit-the-job designing by Permite engineers enable Permite Castings to give longer, better service! You save three ways with Permite and get better appearance, a better product.

#### ALUMINUM INDUSTRIES, INC.

CINCINNATI 25, OHIO

ALUMINUM PERMANENT MOLD, SAND and DIE CASTINGS... HARDENED, GROUND and FORGED STEEL PARTS

## are you overlooking these bets in designing for lower costs?

In many cost reduction programs, too often the power transmission, timing or conveying method is taken for granted... the possibilities for cost reduction and improved performance overlooked. Equipment is redesigned... new equipment developed but with the same basic power transmission or conveying medium that has served for years.

In case after case, important savings in cost... increased efficiency have resulted when these basic functions have been redesigned. And that's where the complete Chain Belt line can help you. You can select the exact chain that best fits the operating conditions or horsepower and speed requirements.

Where operating conditions call for a cast chain, you'll find the exact type and size needed. If speeds and horsepower call for a finished steel roller chain, again you'll find the exact chain you need. Where loads are extra heavy or operation is in dusty, dirty locations, a steel Chabelco chain may be the answer.

Because their chain line is complete, Chain Belt Field Sales Engineers can recommend the chain that is right for your applications... for lowest overall cost. They are not handicapped by the restrictions of a limited line... can, without prejudice, recommend cast or steel chains in the size and type that are best for your machines.

Your Chain Belt Field Sales Engineer will be happy to review your chain selection and application problems. Or, if you prefer, simply fill in the coupon at the right for descriptive bulletins on the Chain Pelt Company line.



#### CHAIN BELT COMPANY

REX CHAIN & TRANSMISSION DIVISION

Milwaukee 4, Wisconsin

BALDWIN-DUCKWORTH DIVISION

Springfield 2, Massachusetts



BALDWIN-REX ROLLER CHAIN available in a complete range from 1/4-inch to 21/2-inch pitch for high speed power transmission and timing.



BALDWIN-REX DOUBLE PITCH ROLLER CHAIN for economical power transmission and conveying under slow speeds.



BALDWIN-REX "BA" ROLLER CHAIN, a new development in the larger pitch riveted chains with a single pin connector that makes assembly and disassembly easy.



BALDWIN-REX LEAF (Cable) CHAIN, an economical chain for lifting or pulling service particularly on hydraulic mechanism.



BALDWIN-REX PLATE TOP CHAIN for conveying bottles or fars where centers are long and loads moderate to heavy.



REX TABLE TOP CHAIN for conveying bottles, jurs, cans, packages, small parts where smooth transfer and cleanliness are required.



REX DETACHABLE CHAIN, available in both pressed steel (shown) and cast types for light drives and conveyor service.



REX PINTLE CHAIN, a drive and conveyor chain used where long life due to greater bearing area is needed.



REX H-TYPE CHAIN for use extensively for drive and transfer service where the wide wearing shoes add life in sliding applications.



These chains are representative of the complete Chain Belt Line. There are many other sizes and types as well as a complete range of chain attachments for every type of conveyor



REX COMBINATION CHAINS, suitable for general elevating and conveyor work at slower speeds where low cost and high strength are needed.



REX DROP FORGED CHAINS, used for trolley conveyors or floor-type sliding conveyors.

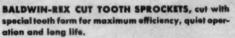


REX CHABELCO STEEL CHAINS, available in a range of sizes from 1 1/4-inch to 36-inch pitch for drive and conveyor service under moderate to heavy loads.



**BALDWIN-REX FLEXIBLE COUPLINGS** are shock absorbing, eliminate back-lash, are easy to install. Made in 5 styles for every coupling service.

REX CAST TOOTH SPROCKETS, made of close grained gray iron. For greatest resistance to wear, available in Rex Temperim.

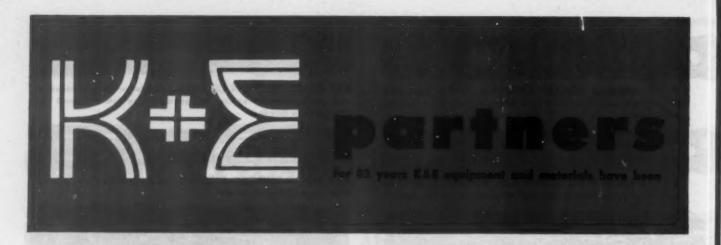




#### Chain Belt District Sales Offices

Midland Atlanta Milwaukee Birmingham Minneapolis Boston **New York** Buffalo Philadelphia Chicago Pittsburgh Cincinnati Portland Claveland Dallas Richmond Salt Lake City Detroit Houston St. Louis Indianapolis San Francisco Jacksonville Seattle Kansas City Springfield Los Angeles Tulsa Louisville Worcester

-	CHAIN BELT COMPANY 1643 W. Bruce Street, Milwaukee 4, Wis. Gentlemen: I am particularly interested in
0 × ×3	☐ Please send me descriptive bulletins.☐ I would like to have a Rex Field Sales Engineer call on me regarding my chain application problems.
1	Name
	CompanyDepartment
1	Address





#### PHOENIX WYTEFACE Non-metallic Woven Tapes

Trade Mari

U. S. Pat. 2,321,920

OVER 3 TIMES LONGER WEAR. An enormous stride. A radical development. The new non-metallic PHOENIX WYTEFACE, as one highway engineer puts it, "bas at least three times the life of ordinary metallic tapes". Drastic field tests — in extremes of climate, in water and mud, over stones and rocks, under truck wheels, through brush and barbed wire —have established that fact.

Here is the reason. PHOENIX WYTEFACE is a weave of amazingly strong synthetic yarns—a scientific wartime development—completely covered and protected by a special tough plastic coating that is not affected by water, is not brittle and will not flake.

MORE ACCURATE, PHOENIX WYTEFACE will stand up to repeated soaking and drying and still

maintain a dimensional stability substantially higher than that of ordinary so-called "metallic" tapes.

HIGHER DIELECTRIC CONSTANT. PHOENIX WYTEFACE Woven Tapes are entirely non-metallic—a feature that is important to Power and Utility Companies and to anyone working near high tension circuits.

EASY TO READ AND CLEAN. The clear black and red markings on the white background are easy to read. The surface is easily wiped clean.

Ask your K&E Distributor or any K&E Branch to show you the new PHOENIX WYTEFACE nonmetallic Woven Tape, or write on your letterhead for a sample length to Keuffel & Esser Co., Hoboken, N. J.

# In Grecience and the edential in shaping the modern world

#### NEW K&E WIDE FRAMED TRIPODS GIVE MAXIMUM STABILITY

The wide framed leg construction of these new K&E tripods and the wide, all-metal hinges joining the legs and head result in great torsional stability. This makes the instrument much steadier—less vibration—in windy weather. Legs are straight grained maple. They are easy to plant firmly, because of their long steel "Stoodite" tipped shoes and large spurs—the kind a man can get his foot on, even with boots or galoshes. The head fits all instruments with the standard  $3\frac{1}{2}$  inch by 8 threads. K&E Wide Framed Tripods are made in stiff leg and extension styles. Ask your K&E Dealer or Branch to show you these

tripods, or write to Keuffel & Esser Co., Hoboken, N. J.





#### ALBANENE\* TRACING PAPER WILL NOT DETERIORATE WITH TIME

ALBANENE Tracing Paper is made from a 100% pure rag base. Its fine printing transparency is due, not to oils that leak and "bleed," but to a synthetic transparentizer that K&E developed specially for this purpose. Prints made today from drawings made on ALBANENE years ago, prove conclusively that ALBANENE does not turn

brittle nor lose its transparency with time.

Ask your K&E Distributor or any K&E
Branch for a sample
or write to Keuffel
& Esser Co.,
Hoboken, N. J.

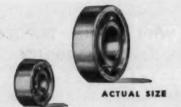
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KEUFFEL & ESSER CO

CHICAGO ST. LOUIS - DETROIT - SAN FRANCISCO

The
Practical
Solution
to Your
Small
Bearing
Problems.



#### NORMA-HOFFMANN Small BEARINGS ...

Wherever your designs call for *small* bearings, that's the time to *specify* and *use* Norma-Hoffmann Small Bearings. For like all Norma-Hoffmann bearings, these small precision bearings are engineered to give efficient, trouble-free service for years on end. They are extra quiet in operation . . . require little if any maintenance . . . improve the performance of the product.

Write for catalog describing these small bearings as well as other Norma-Hoffmann Bearings. They are available in a wide range of types and sizes from 1/8" to 221/2" bore . . . a type and size to meet every speed, load and duty.

## NORMA-HOFFMANN Precision BEARINGS

NORMA-HOFFMANN BEARINGS CORPORATION STAMFORD, CONN.

Field Offices: New York • Chicago • Cleveland • Detroit • Cincinnati Los Angeles • San Francisco • Dallas • Seattle • Phoenix

You can be SURE.. IF IT'S Westinghouse



Westinghouse Oil-Tite Control Stations and Units improve control operations on all types of pilot-control circuits and controllers. Their unit flexibility makes possible attractive installations to suit particular needs.

For surface mounting, they are available in handsome, die-cast Bonderized enclosures. The sleek design and smooth, baked enamel finish harmonize with modern industrial design. Contact blocks may be mounted in the base, eliminating flexible leads from box to cover. Nine operator assemblies and six enclosures provide circuit combinations for any requirement.

When it is desired to mount units in machine cavities, or in banks in large control stations, the contact blocks may be mounted in the conventional manner. For flush mounting in machine cavities, the controls can be purchased with covers only.

which become convenient and attractive flush plates.

Get complete information from your nearby Westinghouse office. Ask for bulletin DB-15-022. Or write Westinghouse Electric Corporation, P. O. Box 868, Pittsburgh 30, Penna.



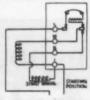




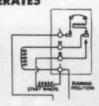
#### HERE'S HOW IT OPERATES



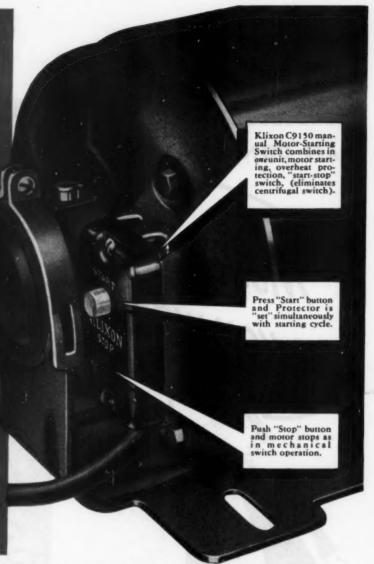
Schematic wiring diagram shows switch in "off" position. The switch incorporates two sets of normally open contacts and a Klixon Manual reset Protector.



Pushing "start" button closes contacts energizing both main and phase windings ...latches button in running position ... sets protector.



The "start" button is then released opening phase winding contacts but main winding contacts remain closed and the motor runs.



- Provides positive Motor Burnout Protection.
- . Eliminates the need for centrifugal switches.
- Replaces separate "On-Off" line switches.
- Applicable to fractional motors from 1/12 to 1/2 hp.

The new Klixon C9150 manual motor-starting switch "starts" and "stops" the motor, protects it from overheating and burning out, eliminates centrifugal switches.

In operation, three separate functions are combined in *one* compact unit operated by the two buttons on the switch (see schematic wiring drawings at left).

The Spencer thermal Disc provides positive overheat protection... prevents the motor from burning out under dangerous overloads or stalled rotor conditions. When the overload is cleared or motor cools to safe operating temperature, the motor is started by pushing the "start" button which resets the protector simultaneously with the starting cycle.

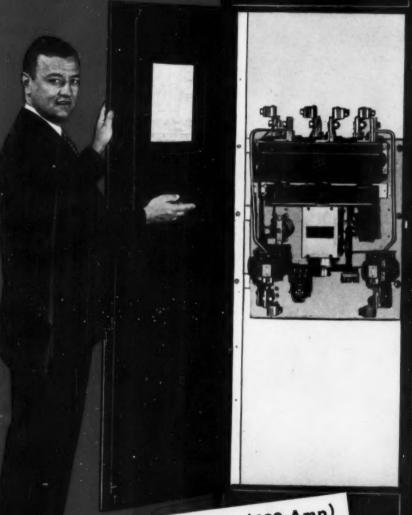
Investigate the new Klixon C9150 manual motor-starting switch. It has a wide range of applications such as, washing machines, bench grinders, ... many types of appliances and equipment using manually started fractional hp. motors from 1/12 to ½ hp.

Because of detailed data required for rating determination this switch is applicable only by motor manufacturers or appliance manufacturers.



SPENCER THERMOSTAT Division of Metals & Controls Corp.
2521 FOREST STREET, ATTLEBORO, MASSACHUSETTS

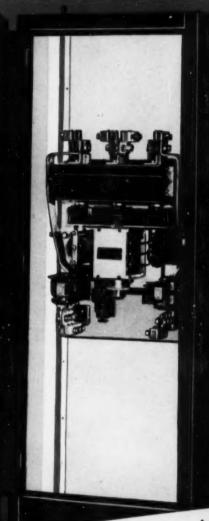
# Announcing... The NEW Size 6 and Size 7 SOLENOID Starters



SIZE 6—(600 Amp)

Max Rating (3 phase): 200

Hp, 220 volts; 400 Hp, 440550 volts.



SIZE 7—(900 Amp)
Max Rating (3 phase): 300
Hp, 220 volts; 600 Hp, 440550 volts.



ALLEN-BRADLEY

SOLENOID MOTOR CONTROL

SEE OTHE SIDE

## of SOLENOID design

in the NEW SIZES 6&7 STARTERS

In years of service, under all operating conditions, the Allen-Bradley solenoid construction has proved its superiority beyond all question of doubt. Now Allen-Bradley has developed Sizes 6 and 7 solenoid starters . . . with all the features that have proved so successful in smaller Allen-Bradley starters. Check its many features.

#### SILVER ALLOY CONTACTS

The double break, silver alloy contacts never require cleaning or filing—a distinct advantage over conventional copperto-copper contacts.

#### SIMPLE, RUGGED CONSTRUCTION

These starters have no pins, pivots, hinges, or complicated mechanisms to cause trouble. The solenoid switch mechanism has only one moving part.

#### SMALLER SIZE

The open type Size 6 starter is less than ¼ as large as conventional starters, and the enclosed unit takes only 58% of the floor space. Size 7 is even smaller, compared with other starters.

#### STEEL PANEL MOUNTING

The switch is mounted on a metal base plate instead of a slate panel, and is self insulated. It can be quickly and easily mounted to metal surfaces without additional insulation.

#### FRONT-OF-PANEL WIRING

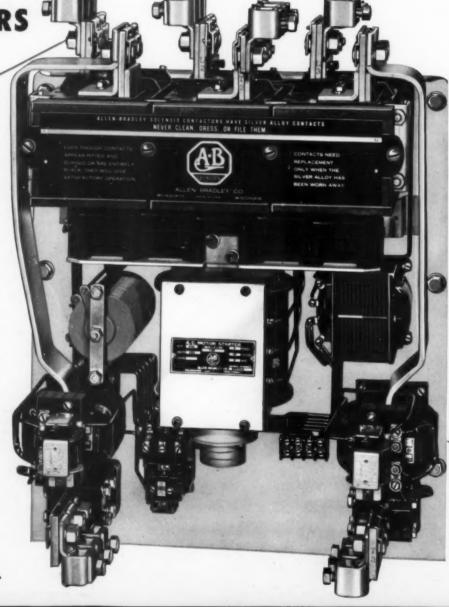
All terminals and wiring are readily accessible from the front. There is no back panel wiring.

#### **AVAILABLE IN MANY FORMS**

Size 6 and Size 7 solenoid switches can be furnished in 2 pole or 3 pole contactors, across the line starters, reversing switches, reduced voltage starters, and many other combinations where clapper type switches were previously used.

#### Write for Information

Allen-Bradley Co., 1316 S. Second St. Milwaukee 4, Wis.





ALLEN-BRADLEY

- minitive

### K-68

the sheet packing that overcomes problems due to "oil swell"

The swelling that takes place when gaskets are in contact with hot oil or gasoline often causes trouble-some or dangerous leaks. K-68 sheet packing was specially designed by R/M packing engineers to overcome this problem in aircraft engines. It meets specification AMS-3232 in all its difficult requirements.

To insure a tight seal between hot metal parts, gaskets that will not be seriously affected by gasolines, naphthas, diesel fuels, and hot oil products, specify K-68.

K-68 is made of selected asbestos fibres, bonded with Neoprene only, under great pressure. It is available in thicknesses from 1/64" to 1/8" and in widths up to 60". For data on K-68 or for the latest R/M packing catalog, send the coupon below.

#### RAYBESTOS-MANHATTAN, INC.

PACKING DIVISION, MANHEIM, PA. | FACTORIES:

FACTORIES: Bridgeport, Conn.; Manheim, Pa.; No. Charleston, S.C.; Passaic, N.J.

RAYBESTOS-MANHATTAN, INC., Manufacturers of Packings • Asbestos Textiles
Mechanical Rubber Products • Abrasive and Diamond Wheels • Brake Linings • Brake
Blocks • Clutch Facings • Fan Belts • Radiator Hose • Rubber Covered Equipment
Powdered Metal Products • Bowling Balls



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	☐ Please send me data on K-68.	
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# send for these

### for your heating jobs

HEATING LIQUIDS "Built-in" electric heat makes your product a better product because it puts the heat right where it is wanted! "Immersion heating" with G-E Calrod\* heaters places heat source into the material to be heated . . . for maximum heat transfer with minimum heat losses.

HEATING PIPELINES G-E heating cable and Calrod tubular heaters keep viscous liquids free-flowing and protect pipelines and valves in cold weather . . . a wealth of "how to" information on installation, application and power requirement calculation.

HEATING PROCESS AIR How and where to apply G-E strip, Calrod tubular and fin Calrod heaters for drying, baking, warming, curing and a wide range of industrial processes and equipments.

HEATING SURFACES Whether it's an eighth-inch soldering iron tip or 100 square-feet of platen surface, this bulletin tells you how to calculate your heating requirements . . . which G-E Calrod heater to use and where and how to install it.

MELTING SOFT METALS Here's how you can achieve fast melting and fully automatic temperature control of babbitt, solder, lead, tin, and type metals—with reduced operation costs, less maintenance, and cooler working conditions.

ELECTRIC HEATERS AND HEATING DEVICES New revised catalog lists a wide variety of heaters and devices to meet almost any conceivable heating requirement.

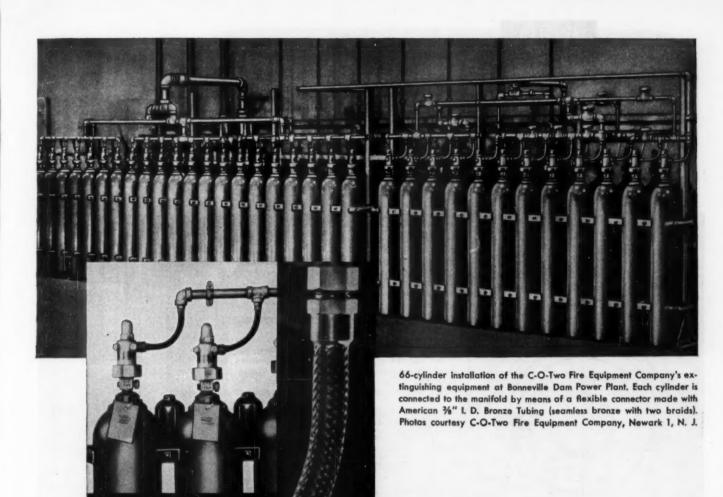


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DON'T MISS "HEAT-WHERE YOU WANT IT!" Latest sound slide-film in the MORE POWER TO AMERICA series depicts case histories of the above five basic applications of electric heat. Ask your local power company representative or contact the nearest G-E Sales Office.

BEFORE you design your electrically heated machinery or equipment . . .

BEFORE you convert existing installations . . . consult the G-E apparatus salesman who regularly calls on you or a G-E Industrial Heating Specialist . . . his recommendations will pay you real dividends in terms of more efficient heating and better designs.



## They wanted these cylinder connections simple . . . and safe

So they used American Seamless Flexible Metal Tubing for the 66 manifold connectors in this installation. Couplings swing freely and accurately into line. No struggling with rigid or semi-rigid pipe or tube.

Resists corrosion, heat and cold; minimizes vibration. American Seamless Flexible Metal Tubing can be flexed

thousands of times with no danger of failure—carries thousands of pounds pressure safely. For flexible metal hose or tubing designed for use with almost any gas, vapor, liquid, or even semi-solid, consult The American Brass Company, American Metal Hose Branch, Waterbury 20, Connecticut. In Canada: The Canadian Fairbanks-Morse Company, Ltd.

wherever connectors must move ...

American

FLEXIBLE METAL HOSE AND TUBING

# MEGILL PARAMETERIA MULTIRIUL RABES WITH ALE DIT FOT OFF CF Series

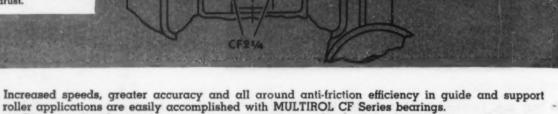
## HOW TO ANTI-FRICTIONIZE WITH CAM FOLLOWERS

the MULTIRUL way

Right: Bottle filling machines require less care and maintenance when Multirol CYR Series (nostud) bearings are used for the lifter head. Plain bearings stick and slide, causing wear on the cam operating mechanism Multirol CYR Series bearings roll freely and smoothly and maintain proper machine adjustment

Left Considerable labor and costly machining is saved by using Multirol CF Series bearings in the shifting fork collar mounting Operates smoothly and eliminates friction found in conventional bronze collar types Stud of Multirol CF bearings threads directly to fork fingers.

Right: As guide rollers Multirol CF Series bearings for overhead Tramrail Wheels eliminate cost of flanged wheels that ordinarily wear excessively. Provide freer rolling, better alignment and positive side thrust.



Constructed with extra heavy outer race sections to take shock load and many small diameter rollers to evenly distribute heavier radial loads . . . result is smooth performance at high speed and reduced power requirements not possible with bolt and roller units.

Lubrication is simplified with facilities provided for greasing and constant oiling and frequent adjustment due to rapid wear of plain bushings is eliminated.

Design these many anti-friction advantages into your machines with CF Series bearings for conventional stud mounting. Use the CYR Series bearings for shaft mounting without stud.

Easily applied and available in many standard sizes from conveniently located stocks. Write today for our engineering department's helpful recommendations.



Address McGill Manufacturing Company, Inc. 200 No. Lafayette St., Valparaiso, Indiana for your copies of Bulletins CF-40 and CY-48



CROWNED OD

#### ... with packing standards



In the movement sponsored by the Joint Industry
Conference to set up packing standards, reduce
number of sizes and promote interchangeability,
Houghton was first to prepare and distribute such
simplified standards.

The booklet shown here contains tables of sizes and dash numbers for convenience in ordering. The packing industry generally and the large users have accepted these standards.

That's one valuable aid to industry from this pioneer in hydraulics. Another is the service to designers . . .



#### ... with standard packings

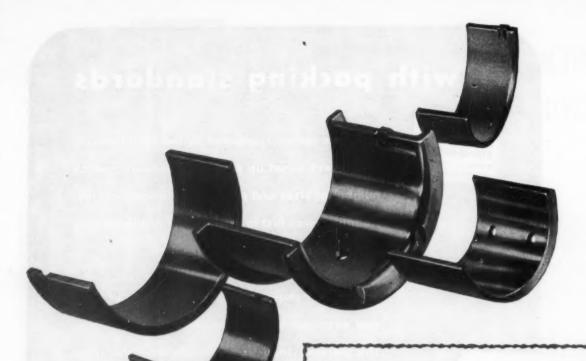


These include leather and synthetic rubber styles

—"V", "U", Cup. "O" rings and leather back-up
washers.

Let Houghton make a specific recommendation on your next design and if there is trouble on a hydraulic installation due to imperfect sealing, let the Houghton engineer examine the packing set-up. A letter to E. F. Houghton & Co., 303 W. Lehigh Ave., Phila. 33, Pa., will bring results.

For "know-how" know Houghton



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Complete Range of Alloys
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When you specify sleeve bearings, you get the advantage of a complete service at Federal-Mogul, in research, engineering and production, plus 50 years of specialized sleeve bearing experience. Each of our seven manufacturing plants specializes in production within a specific range of alloys and sizes, from tiny bushings to giant bearings up to 271/2" diameter. In each plant our Quality Control group carries research and engineering quality standards into every phase of manufacture, from checking the quality of raw materials through to your finished bearing. A typical bearing,

whether it is one of an order for 500 or for 50,000—will receive as many as 108 measurement checks, analysis, temperature and special tests and visual examinations before it is released for delivery. That's how fine performance is built into every Federal-Mogul silent sleeve bearing you receive. Whatever your requirements, without obligation, consult our research or engineering service.

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1899 - Fifty years of continuous bearing experience - 1949

This table gives the essential characteristics of Arma Induction Generators. The information may suggest applications of these components to your designs.

## To Top Flight Development, Design and Instrumentation Engineers

TYPE	FREQ.	INPUT		OUTPUT		RESIDUAL AT O SPEED (m.v.)			ROTOR		ALLOW, MAX.		
		VOLTS	AMPS.	WATTS	Voits pur 100 R.P.M.	Specified R.P.M.	Phase	In-Phase	Quadrature	Harmonic	Oz. in.2	WEIGHT (lbs.)	STATIC FRIC. Or. In.
1A60	60	24	0.18	2.0	0.33±5%	900	0°±1.5°	10	10	10	0.22	1.5	0.2
5E	60	90	0.15	5.0	1.0 ±1%	600	0°±0.5°	5	5	15	2.60	4.3	0.75
OSADC	DC	24	0.15	3.5	0.070 V.D.C. (approx.) for an acceleration of 1400 Radians/Sec. <sup>2</sup>						0.019	0.54	0.1
3	DC	38-46	0.12	5	0.1 V.D.C. (approx.) for an acceleration of 1400 Radians/Sec.2					0.25	3.0	1.0	

## Induction Generators that serve importantly in ARMA'S Post-War Technique of electrical "BRAIN BLOCK" instrumentation

"Brain Block" instrumentation quickly describes any custom arrangement of light, small, accurate standard Arma components to make precision instruments and controls.

#### Wide Use for Tachometer Type

Arma's 1A60 and 5E Generators are of the tachometer type. They generate an A.C. voltage equal to the product of excitation voltage and rotor speed with minimum introduction of phase shift, harmonics or quadrature voltage. The linear voltage speed characteristics of these units over wide speed ranges and the low level of quadrature and harmonics at very low or zero speed indicate their selection where a voltage proportional to speed is required. The units are designed to minimize sensitivity to temperature changes and each is calibrated and standardized for complete

interchangeability. Advantages include: linearity deviations extremely small over wide speed range; minimum phase shift; and low residual voltage.

#### Where to Use Acceleration Type

The Arma 3 and 03ADC Generators are of the acceleration type. This type is D.C. excited and its output is a D.C. voltage proportional to acceleration of the rotor. It is extremely useful in servo systems having severe damping requirements and in systems where it is necessary to measure or limit the acceleration.

#### Features of Arma Ind. Generators

- Rugged construction and high mechanical accuracy.
- 2. Low friction and inertia.
- 3. High output to inertia ratio.

#### 4. Engineered precision.

#### New Opportunities in Other Arma Components, too

While you re-examine, in the light of these Generators, designs once limited by available components, it may pay you to have up to date information on: Arma Synchro Units for remote control and indicating purposes; two-phase Induction Motors for servo-mechanisms and control devices; Electrical Resolvers for solving problems involving triangles, coordinates and vectors; high-precision Mechanical Differentials for instrument applications; D.C. Step Motors for remote control purposes; and, Induction Potentiometers for the smooth, stepless rotation required in modern "Brain Block" instrumentation.

Entering its 32nd year, Arma Corporation is so fully committed on urgent defense projects as to preclude its presently undertaking industrial instrumentation. However, you are invited to request whatever information you may need to explore the possibilities of making use of any Arma product which has been released from security restrictions.

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When You Need

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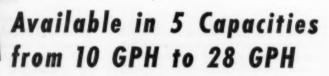


Pumps...



Here's a low cost pump to use where pressure and inlet ports are fixed, but where power shaft rotation may be in either direction. Here's the pump to use in lubrication systems where power shaft rotation is reversed during the operation cycle. It has the quiet operating, efficient Rota-Roll pumping members common to all Sundstrand constant volume pumps and is precision made. An integral relief valve is incorporated in the pump for maintaining the lubricating system at the valve setting.

The 5LWX is flange mounted and manifold connected to the drive shaft mounting.



The 5LWX is furnished in five different capacities of 10,14,16,20 or 28 GPH at 1200 RPM. Pump is suitable for operation up to 2000 RPM and a maximum continuous pressure of 150 PSI. Pumps may be furnished with or without relief valve.

#### FREE Additional Data

Write for complete data on this low cost, low pressure Sundstrand pump. Ask for bulletin M-48.





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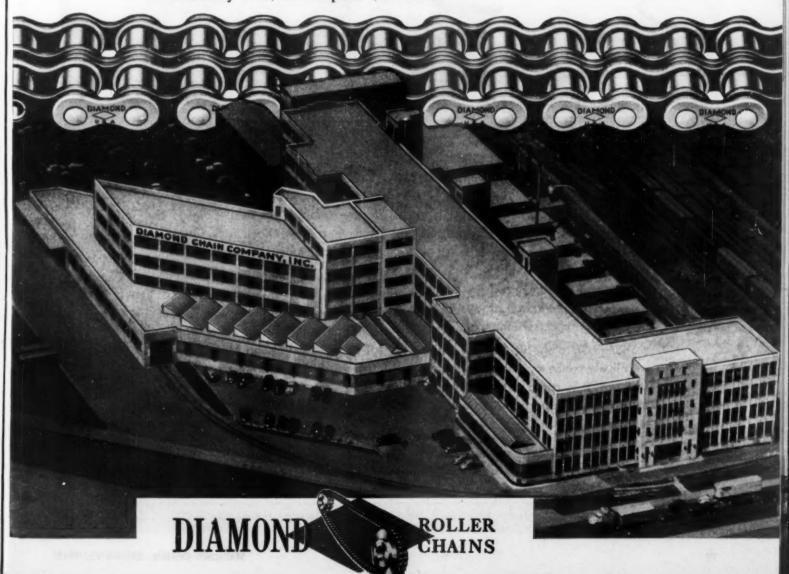
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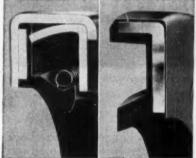
TEXLITE\*

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#### NATIONAL OIL SEAL LOGBOOK

## FOR OSCILLATING OR RECIPROCATING SHAFTS

Good oil seal design and construction must allow for some shaft eccentricity, shaft whip and end play—conditions which are present in all but the most precisely machined equipment. However, when shafts are required to oscillate or reciprocate, careful attention should be given to the shape and thickness of the sealing members and to correct spring tensioning.



32222222222222222222222222222222

Figure 2 Figure 3
Syntech spring-loaded Syntech springless variation for reciprocating shafts or oscillating shafts

In the case of reciprocating shafts it is usually better to utilize a springless Syntech type oil seal with heavy straight lip sealing member. Limited contact seals should be avoided because the sealing members are apt to buckle or fold over under the quick reversals of shaft movement. The National Syntech oil seals shown in Fig. 1 and 3 with heavy Syntech sealing member section provide excellent performance on reciprocating shafts. Springless type leather (Fig. 4) seals are ideal

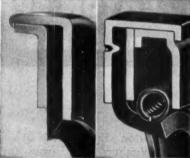


Figure 4 Figure 5
Springless leather dust wiper for reciprocating shafts shafts

as auxiliary dust wipers on reciprocating shafts.

The oscillating shaft does not pose as difficult problems as those encountered with reciprocation. However, care should be exercised in providing rugged sealing members that maintain somewhat broader contact with the shaft. If springtensioned seals are required, tensioning should be adjusted in order to prevent buckling.

National engineers have been suc-

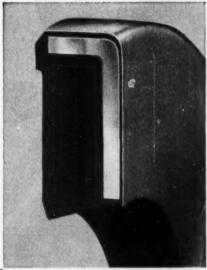


Figure 1
Syntech springless, ideal type for reciprocating shafts

cessful in helping solve many difficult and exacting problems of sealing around oscillating and reciprocating shafts. New National Syntech\* (synthetic rubber) sealing members (Fig. 1, 2 and 3) which can stand extreme temperatures; specially impregnated (Nationalized) leather sealing members (Fig. 4 and 5) and precisely manufactured oil seal cases have been utilized. This experience is available to you at any time without cost or obligation.



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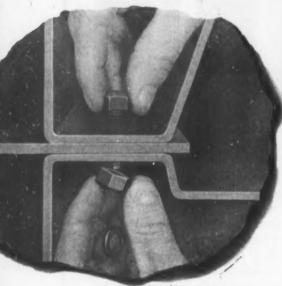
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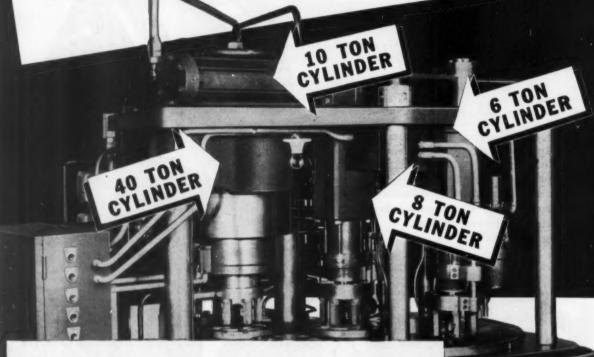
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MALLEABLE NUT PRODUCTION

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All moving parts are controlled hydraulically by T-J Cylinders—on this Malleable Nut Production Machine designed and built by Roy Hays & Associates, Rockford, Ill., for the Wagner Malleable Products Co., Decatur, Ill.

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the job of cutting off sprue, sizing, boring, facing, chamfering and threading 2,500-3/4 std. pipe thread nuts per hour.

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There's no magic to it—just a motor that's built the way production men want their motors built. And more and more spec sheets carry the message "DELCO PREFERRED" to take advantage of the extra care and extra features that make Delco motors outperform all others. Here are a few of these performance extras:

Why not get all the facts on Delco motors? Phone or write Delco Products, Dayton, Ohio... or get in touch with one of the sales offices listed below.

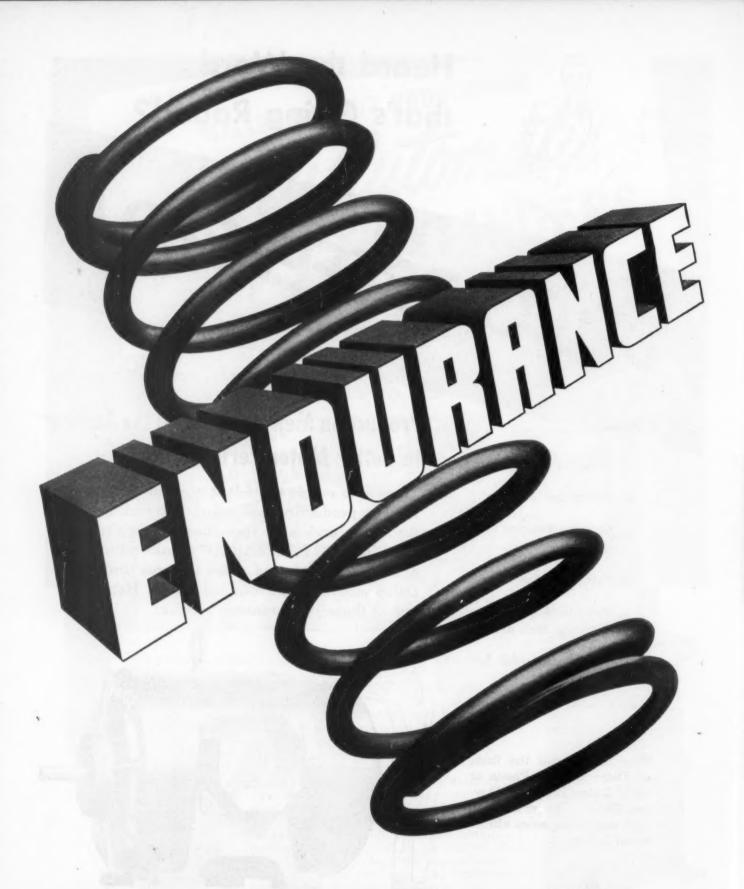




### **DELCO MOTORS**

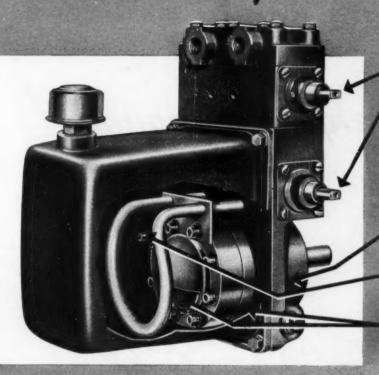
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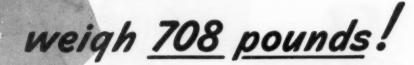
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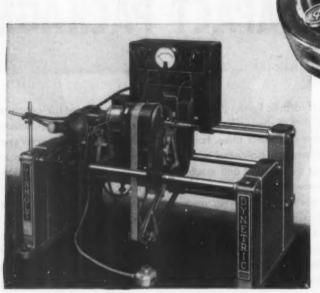
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The Gisholt DYNETRIC 3S Balancing Machine shown above is one of many sizes and types available to handle parts weighing from a fraction of an ounce to many tons. Write for literature on the complete line of "S" machines.



Yes, one of those little coppers in your pocket can exert enough "pull" to amaze you.

It's simple dynamics—centrifugal force. To start with, it weighs only % ounce. Put this "unbalance" weight on a rotating body at 6" from the center and let's see what happens. At 500 r.p.m. it exerts a force of .44 pound. Now, speed it up. The centrifugal force increases as the square of rotational speed. At 5,000 r.p.m. it becomes 44.25 pounds. At 20,000 r.p.m. the % ounce becomes a force of 708 pounds on the restraining bearings. Such unbalance in rotating parts causes vibration. And that means trouble in high-speed rotating assemblies—excessive wear, shorter life.

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For integral mounting, each size pump is furnished also as a stripped model with housing, or stripped model without housing. Easily installed with minimum number of machining operations. Complete information available in new Bulletin. Brown & Sharpe Mfg. Co., Providence 1, R. I., U. S. A.

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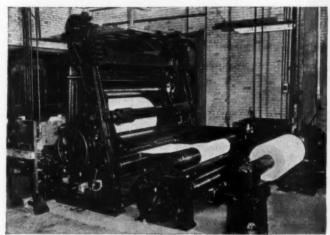
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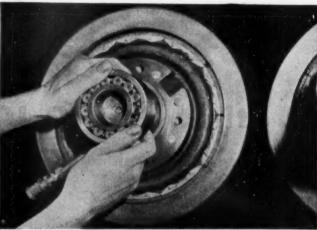
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BUNDYWELD NICKEL AND MONEL TUBING IS SOLD BY DISTRIBUTORS OF NICKEL AND HICKEL ALLOYS IN PRINCIPAL CITIES.

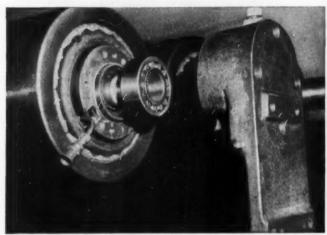
## Torrington Spherical Roller Bearings maintain roll accuracy and alignment in CAMACHINE slitting and winding units



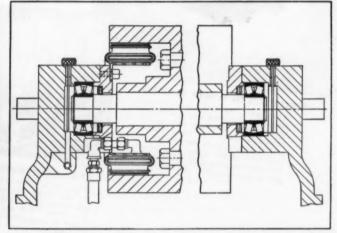
Modern paper converting machinery must be fed from uniform paper rolls. The Cameron Machine Company, Brooklyn, New York, has specialized for more than 43 years in the manufacture of slitting and winding machines, such as the Camachine 18 shown above, that will produce clean-edged, even wound rolls.



An important engineering feature of all Camachines, that assures even tension on the web and smooth, even winding, is the use of Torrington Spherical Roller Bearings on all through shafts. Despite center distances as high as 162", these self-aligning bearings make it easy to secure accurate alignment of shafts.



On idler rolls, above, Spherical Roller Bearings turn freely, with minimum friction, under the weight of heavy paper reels. They compensate automatically for deflection. Since the bearings cannot bind or drag, they provide insurance against a torn or twisted web, and reduce power requirements to a minimum.



Cross-section of an idler roll shows the application of two of ten Spherical Roller Bearings used in the Camachine 18. The angular location of the rollers with reference to the bearing axis provides thrust capacity and eliminates end play, another important feature in producing even paper rolls.

Wherever shaft deflection or misalignment is a problem in heavy-duty equipment, the free-rolling self-alignment of Torrington Spherical Roller Bearings assures long service life with minimum maintenance. Let our engineers help you with specific design problems. The Torrington Company, South Bend 21, Ind., or Torrington, Conn. District offices and distributors in principal cities of United States and Canada.



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Spherical Roller . Tapered Roller . Straight Roller

Needle - Ball - Needle Rollers



Forward-looking design engineers find that Microcast, for small components, offers many opportunities for product improvement and substantial savings in cost. This is particularly true where resistance to wear or corrosion is desired or where the part is of intricate shape, requiring expensive machining operations under conventional production methods.

With the Microcast Process, the unusual properties of the extremely hard, high-melting-point alloys can be used to full advantage. Small components of intricate shape, as cast, are dimensionally uniform, of sound structure, and to such close tolerances that little or no machining is required.



The "guts" of any turbine-type power development un.t is its power blading. The Microcast Process has produced millions of these blades, utilizing the high-melting-point, non-machineable alloys at substantially lower costs than other methods of manufacture.



TIME FOR REFRESHMENT

When you step up to your favorite fountain chances are the syrup for your soda, pumps through a Microcast dispensing part. What's important is that these 18-8 stainless steel Microcastings resulted in considerable savings in die and machining costs over previous production methods.



At least the operation is not com-At least the operation is not com-plete until the modern hay baler goes into action! A Microcast gear on the knotter twine disc assembly eliminates the costly milling and hobbing operations ordinarily re-quired to form teeth.

Microcastings...IN A WIDE VARIETY OF PRODUCTS

#### AFFORD BETTER PERFORMANCE AT LOWER COST



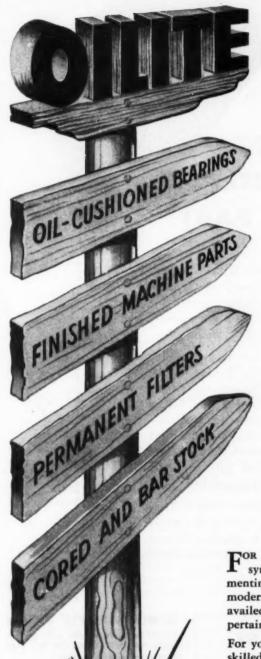
More complete information on Microcast is contained in a new 16-page booklet published by Austenal Laboratories, Inc., originators of the Microcast Process. The booklet describes many applications for Microcasting and also explains the process itself. Write for your copy today.

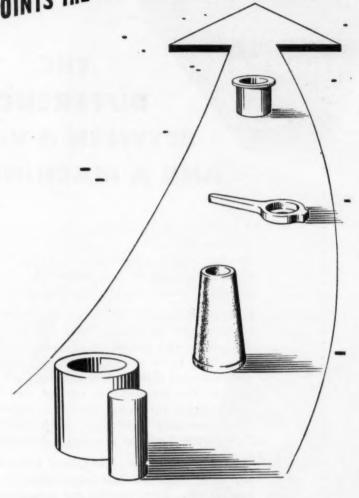
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#### MICROCAST DIVISION AUSTENAL LABORATORIES, INC.

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## POINTS THE WAY TO





FOR MORE than 20 years many of you have said that to you Oilite is synonymous with quality. You have been enthusiastic in complimenting us upon the recent completion of our new plant with its modern equipment and flexible production facilities. Some of you have availed yourselves of Amplex's engineering service other than that pertaining to Oilite Products.

For your kind trust, we are humble and proud. To maintain that trust, skilled Amplex personnel is constantly engaged in the forward engineering of Oil-Cushioned Oilite Bearings, Finished Machine Parts, and kindred products-designed to meet your specific needs. Your objective is our objective-superior products, increased sales appeal, greater economy, and encompassing service. Our field and home office engineers welcome the opportunity to work with you.

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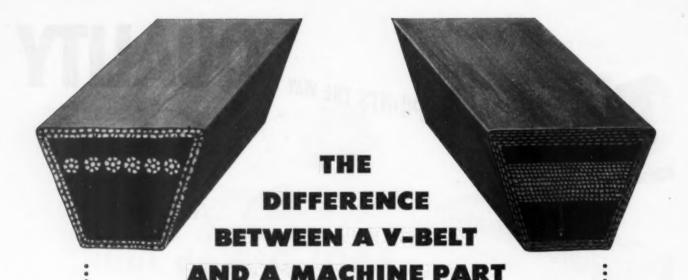
AMPLEX MANUFACTURING CO., 6501 Harper, Detroit 31, Mich.

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A V-Belt can be thought of as just that much belt. But if you think of its essential part in the machine's whole economic and production function, then you want only the kind of belt that provides for the load as compactly as possible, runs smooth, conserves power, safeguards steady output—and keeps on doing those things.

Gilmer V-Belts-make good on all those counts, for strictly tangible reasons—one big reason being Gilmer Rayon Pulling Cords. They fit in with modern engineering design because they don't need bulk to be strong. Therefore they are positively locked and cushioned all around, even in Gilmer V-Belts of limited cross-section. You get negligible internal cord friction, despite short centers and sharp flexing. Since these high-strength Gilmer Rayon Cords are fully controllable when made, and then specially "normalized," you get matched V-Belts that stay matched.

Now look into all the other Gilmer V-Belt features—below. They add up to more than belt improvement; you improve the whole machine, the drive, and the cost components, by applying Gilmer V-Belts—made in all standard and numerous special sizes listed in the Gilmer Mold List. Ask for book 135.

#### GILMER FHP V-BELTS

Straight Sidewalls: contact with groove walls the full height of the side assures maximum grip.

Strong Rayon Single Strand Pulling Cords: "normalized" against stretch and fatique.

Deep Cushion Rubber Section: preserves grip, cross-section and coolness.

Double Jackets: for lasting anti-slip grip and internal protection.

#### **GILMER SUPER-SERVICE BELTS**

Nylon Pulling Cords! Neoprene body! Most revs per dollar!

#### NOW-ZERO SLIPPAGE with Gilmer "Timing" Belts.

The engineer's dream fulfilled by Gilmer!... Belt drive fully as smooth and positive as any transmission known... Now made possible by the flat, endless, steel-corded Gilmer "Timing" Belt, with teeth engaging axially-grooved pulleys, for perfectly synchronized speeds. You can make radical improvements in transmission layouts. Write Gilmer for details.

Flat belts for original equipment manufacturers dre covered in the New Gilmer Belt Catalog. Just out. Ask for your copy.

#### GILMER MULTIPLE V-BELTS

Straight Sidewalls: contact with groove walls the full height of the side assures maximum grip.

Locked Rayon Ply Pulling Cords: brute strength without friction effects.

Top and Bottom Rubber Sections: expertly balanced to make a cool flexing belt.

Sturdy Jackets: resist wear and slip; guard the belt's interior.

Controlled Stretch: special cord processing preserves matched lengths.

#### Gilmet has the Pull

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Industrial Research Laboratories uses

### CLARE RELAYS

in Electronic Crown
Detector Unit for
Bottling Machines

Send for CLARE

Engineering Data Book

Engineering Data Book

This book, sent on request,
pictures and describes the
pictures and describes of recomplete CLARE line of recomplete CLARE line of relays and allied control aplays and allied control apparatus to meet the widest
paratus to meet the widest
paratus of industrial uses.

Typical bottling installation showing Red Diamond Electronic Crown Detector in operation.

Cover of control box removed to show installation of CLARE Type "C" Relay.

This electronic device warns of any interruption of the crown supply in bottling operations. It is sold by Liquid Carbonic Corporation of Chicago and manufactured by Industrial Research Laboratories of Baltimore, Md.

A bottle feeler switch is inserted in the control grid circuit to close the circuit when a bottle passes between the poles. If a crownless bottle passes, an electronic tube momentarily operates the CLARE Type "C" Relay and an alarm sounds for a few seconds. Passage of the second crownless bottle causes the CLARE relay to stop the machine on the second operation.

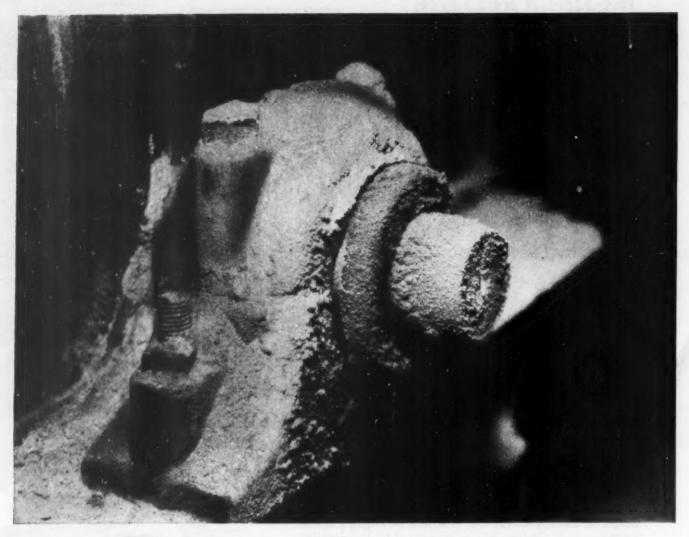
CLARE relays were selected by Industrial Research Laboratories for this important operation because of their long reputation for accurate, long-life performance as components of devices designed for trouble-free operation, day in and day out. In larger plants, more than a million bottles per week pass through the machine.

If you have a difficult relay problem, a requirement where ordinary relays just won't do, why not take it up with our engineers? CLARE sales engineers are located in principal cities. They are experienced in the most difficult types of relay problems. We invite you to take advantage of their services. Call them direct . . . or write to C. P. Clare, 4719 West Sunnyside Avenue, Chicago 30, Illinois. In Canada: Canadian Line Materials Ltd., Toronto 13. Cable address: CLARELAY.

CLARE TYPE "C" RELAY

CLARE RELAYS

First in the Industrial Field



#### DEFIES ABRASIVE DUSTS!

The Famous Dodge-Timken Type C Bearings
in Your Plant Assure <u>Uninterrupted Production</u>



POSITIVE TRIPLE SEAL

-ANOTHER

DODGE "FIRST"

WHEN you grind steel, cement, iron or rock you get dust — powdery, abrasive dust that seeps everywhere—except into

Dodge-Timken Type C bearings like the one pictured above, which keeps the mill on which it is installed running smoothly at 3000 r.p.m.!

Wherever you have operating conditions of extreme dust and dirt, standardization on the Type C is your answer. Triple steel seals keep the lubricant in and the dirt out of this bearing, and in thousands of installations Dodge-Timken Type C pillow blocks are operating successfully under adverse conditions where other bearings failed. Rugged in construc-

tion, fully self-aligning, with both radial and thrust carrying capacity, Type C is suitable for heavy line shaft service as well as many machine applications.

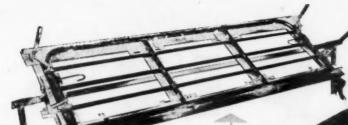
For complete information concerning this bearing and other Dodge "Firsts" in power drive equipment call a Transmissioneer—your local Dodge Distributor. Look for his name under "Power Transmission Equipment" in your classified telephone directory.

DODGE MANUFACTURING CORPORATION, MISHAWAKA, IND.



The Transmissioneer is a graduate of an intensive training course at the Dodge factory. He can help you find the answer in applying power to the job.





Safety slide for hospital bed. 42 half-inch long tack welds plus 6 continuous welds are made on .042" cold rolled steel in 23 minutes, including assembly time.

# SIMMONS STEEL FURNITURE is Bronze Welded

PRODUCT IS STRONGER
ASSEMBLY IS FASTER
COSTS ARE LOWER

COMPARATIVE SAVINGS: Using ANACONDA 997 (Low Fuming) Bronze versus steel welding rod on same operations

40 to 60%

The Simmons Company adds: "Under actual testing, we have a much stronger unit today than if we were using steel welding, due to the fact that the lower bronze-welding temperatures do not weaken the joint areas."

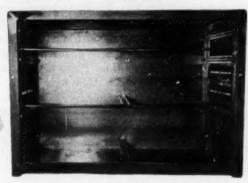
If you do either production or repair welding, write for Publication B-13. It covers all Anaconda Welding Rods, their applications and procedures for their use. The American Brass Company, Waterbury 20, Connecticut. In Canada: Anaconda American Brass Ltd., New Toronto, Ont.

You can depend on ANACONDA

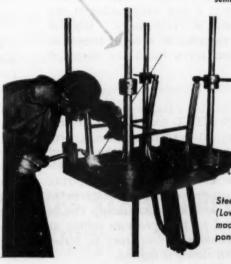
BRONZE WELDING RODS



Bedside cabinet. 2 reinforcing welds, 2 inches long, are made on 20-gage cold rolled steel in 54 seconds.



Steel dresser. 36 welds are made on 20- and 22-gage cold rolled steel. Total time, including assembly, is less than 6 minutes.



Steel chair. 56 ANACONDA 997 (Low Fuming) Bronze wolds are made on each chair, with components aligned in welding fixture.

## TOPICS

X-RAY EXPOSURES of selected planes within an object are now possible by using a spiral laminagraph developed by the Naval Ordnance Laboratory at White Oak, Md. When instrument is in operation, film and object are in continuous, synchronous motion with respect to the tube.

MOTOR GRADER, light enough to travel by air, is capable of doing any job standard models can perform. Being tested for the Navy Bureau of Yards and Docks, the grader is driven through all six wheels by an 80-hp diesel and utilizes lightweight alloys in place of steel, effecting a saving of three tons. Boxes are provided for loading ballast.

DUCTILE CAST IRON, also known as nodular cast iron, has excellent engineering properties, particularly high tensile strength, elastic modulus, yield strength, toughness and ductility. Under patents recently granted to International Nickel Co., more than forty companies are now licensed to produce this new iron. Essential feature of the invention is the introduction of a critical amount of magnesium into the molten iron to produce a graphite structure in the form of spheroids or compacted particles, eliminating a substantial amount of the usual weakening flake graphite.

AIRFLOW ten times the velocity of sound has been achieved in a new wind tunnel at the California Institute of Technology. Highest speed previously recorded in a small tunnel of this type has been seven times the speed of sound.

ALUMINUM-ON-STEEL combination to protect the steel against corrosion is being produced by applying aluminum foil to the top and bottom of the steel sheet. The process, developed by Reynolds Metal Co., involves applying electrolytically a coating of fine iron to provide a permanent bond with the aluminum. Foil is bonded to the sheet by high-pressure rolling at 850 F. The aluminum-clad steel may be rolled further to reduce thickness if desired.

CRANKLESS ENGINE, being tested at Stanford University, may be developed to turn a turbine for driving an auto or truck. Characterized by extreme mechanical simplicity, the engine is lightweight, almost free from vibration and is inexpensive to build, operate and maintain. Suitable for use either as an air compressor or as an all-purpose prime mover, the engine theoretically has higher thermal efficiency than the modern diesel. The engine under test is a German Junkers single cylinder, 40 hp opposed-piston diesel operating on a two-stroke cycle with four steps of air compression.

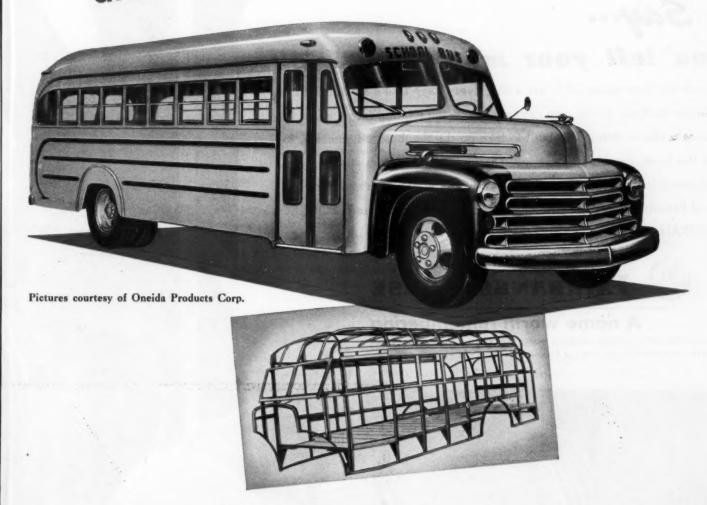
VISUAL COMMUNICATIONS for aircraft are under development to overcome the limitations of voice communication. Advantages of printed messages would include improved accuracy, a permanent record, allowance of an interval between reception and reading, and ability to transmit maps and diagrams.

ADEQUATE PROTECTION of trademarks throughout foreign countries requires revision of the present world-wide system, according to the International Chamber of Commerce. Proposed revisions include: Prior registration in country of origin shall not be a condition for obtaining registration in other countries. Trademarks and translations thereof may be registered in one single act. Right of priority should be reserved for twelve months from date of filing in home country. Licensed use of trademark will be under control of registered owner.

WORLD'S MOST POWERFUL radio station will be built by the Navy at Jim Creek, Wash. Developing more than 1,000,000 watts the station will provide all-weather Naval communications in the area.

ATOMIC POWER PLANTS cannot be judged with respect to their economic possibilities until about \$2 million has been expended for building a number of successive experimental plants, according to C. G. Suits, vice president and director of research for General Electric Co. If a profitable atomic industry does develop he believes it will be decades away.

# FRAMED and COVERED with safety



The greater strength and toughness of N-A-X HIGH-TENSILE steel permits weight savings of up to 25% in section—and still affords maximum protection against injuries from traffic accidents.

Its superior fatigue-resistance and excellent weldability prolongs this safety-factor... reduces maintenance costs over more miles and under all conditions.

If you manufacture a product requiring high strength, toughness and good weldability, it will pay you to investigate N-A-X HIGH-TENSILE.



#### **GREAT LAKES STEEL CORPORATION**

N-A-X Alloy Division • Detroit 18, Michigan UNIT OF NATIONAL STEEL CORPORATION





#### Standards Are Everybody's Business

NGINEERING standards are a unique institution. Although, like regulations, laws and ordinances, they are established for the common good, they require neither enforcement officers nor legal penalties to make them effective. Instead they derive their force from their direct and self-evident value to each user. It follows that failure to establish much-needed standards can have painful consequences, as was amply demonstrated in the recent war. For example, the confusion due to lack of interchangeability between American and British threaded fasteners accelerated the development of the recently adopted unified screw thread standard.

Other much-needed standards are under development, and it is gratifying to observe, as noted on Page 155 of this issue, that one of the most sorely needed—hydraulic packings standards—has reached the stage of approval by the Joint Industry Conference. As with others, this standard reflects much voluntary effort by engineers representing both producers and users. So far as is humanly possible they have tried to evolve a practical and acceptable standard.

But this is just a beginning. Standardization is a continuous process. Frequent review and revision are essential to insure that a standard is neither hampering progress nor being ignored through obsolescence. To keep an engineering standard alive and effective requires the active co-operation of machine designers.

First and foremost, engineering executives must keep abreast of standards developments in the field and how adoption of these standards can help to simplify design, cut costs, facilitate procurement, reduce inventories, etc. They also should see that the fullest possible use of standards is made, thus promoting their acceptance and enhancing their value as well as providing the background of experience necessary to insure their being kept up to date. Finally they should voice their criticisms and suggestions where they will be heard by the committees responsible for maintaining the standards.

The various standardizing agencies such as industry groups, government departments, technical societies, and the American Standards Association need the active support and advice of engineers who use standards. Designers can therefore render valuable service to their profession by urging the establishment of standards where they see a need, by actively participating in standardization committee work, and through constructive criticism of standards in existence or under development.

bolin Carmilael

### Engineering

A plan for effecting successful departmental co-ordination

By Harold A. Bolz
Professor of Industrial Engineering
Head
Department of General Engineering
Purdue University

"...many invaluable suggestions have come from...the shop as a result of intimate and expert association with the prime elements..."

Photo, courtesy General Electric Co.

O-ORDINATION does not just grow; it must be studied, analyzed, and developed before it can be applied to real advantage. Co-ordination is taken for granted as being essential to the successful functioning of the modern complex industrial organization but, like so many things which we accept as everyday necessities, it seldom receives the consideration which its importance justifies; neither is it given the conscientious application which is required to produce its full benefits.

Considering that the life blood of any industry is its products, it would seem obvious that co-ordination is most important between the engineering department and the shop. The engineering department carries the responsibility of determining designs, specifications and controls for the products and production methods with the object of securing the best ultimate relationship between profits, employee welfare, and customer satisfaction. The shop or manu-

facturing department has the responsibility of actually producing the products economically in accordance with the engineering designs and specifications. The interdependence of these two areas of responsibility necessitates very close co-ordination of effort. In certain organizations some of these responsibilities may be shared by departments other than those designated as engineering and manufacturing, such as planning and control, but for the purposes of this discussion the broadest definitions of the terms "engineering" and "shop" will be assumed.

Before proceeding with an analysis of means which may be employed to effect wholesome co-ordination and co-operation between engineering and shop departments, it might be well to recognize specific reasons underlying the importance of such a relationship. Co-ordination between engineers and the shop is necessary in order to ensure: (1) Best possible product designs and production methods, (2) effective appli-

## and Shop Relationships

cation of new materials, new methods and improved techniques, and (3) highest possible morale and the many mutual benefits thereof.

To realize these objectives, engineers must know how their designs and methods will suit the existing production facilities and personnel. They must understand the characteristics and limitations of the various production processes available. Their drawings, specifications and instructions must be prepared carefully and according to company standards so as to be perfectly clear and definite and readily understood by the shop and others using them. They must have ready access to the shop's suggestions for improvements and changes before production is started as well as after it has been put into operation. Progress grows from change but since all changes do not produce progress a very intimate working relationship between engineering and manufacturing is necessary to discover the most advantageous changes, to evaluate suggested changes and to apply them toward the optimum mutual benefit of management, employees and customers.

In order to prescribe means of promoting more effective relationships between the engineering department and the shop or manufacturing department, it is well first to analyze these two groups from the standpoint of the types of personnel of which they are composed, their respective working environments, the nature of their individual responsibilities, and the character of their jobs.

#### Engineers and Shop Men Compared

The first step on the road toward co-operation should be labeled *Understanding*. If each party were to understand and appreciate the other's way of thinking, his personal and group motivations, his job responsibilities and his environment, co-operation and co-ordination would be a natural result. As it is, however, engineering and shop personnel are likely to differ somewhat in a number of respects and consequently each often fails to consider certain vital factors involved in their relationships. These differences greatly influence the actions of these two groups as well as of the individuals in them.

A comparison of engineering and production work, particularly in mass-production industries, yields a significant clew as to the basic differences between the personnel engaged in these two areas of endeavor. Engineering is by its very nature creative while shop work, especially in large-volume production, must needs be repetitive, closely organized, and standardized. As a consequence engineers are expected to be original, inventive, ready to initiate, quick to abandon



one idea in preference to a better one, and always alert to the potentialities of suggestions, criticisms and "wild ideas". Production workers, on the other hand, become tuned to the monotony of standardization, and accustomed to the sameness of the parts and methods with which they work. They too are alert to changes but changes to them may mean not new potentialities but possible trouble; changes to them may signify not opportunities for a better system but breakdown of the system with which they are intimately involved. 'The engineer's progress in his company usually depends upon his record of technological developments whereas shop men work under constant concern, whether it be justified or not, over the possibility of being displaced from their jobs by such technological changes. Engineers, therefore, learn to welcome change, production workers to resist it-both with good and sufficient but dissimilar reasons.

If the engineer is supposed to be a creator and an instigator of change, he naturally develops many viewpoints and traits which differ from those of the shop man who is charged with the responsibility of maintaining precision and sameness. The engineer becomes versatile, flexible and insatiably curious while his coworker in the plant tends toward highly limited and often boring specialization. The engineer produces more effective results when he is charged with the responsibility of using his own initiative and originality while the operator in production often performs his work best when relieved of all such responsibility. This comparison between engineers and shop men is well illustrated by the definition often quoted that "wages are paid for doing what one is told to do, salaries for doing what needs to be done without being told". It is well to recognize here, however, that the boredom of repetitive work often nurtures remarkable degrees of manual and mental skills and

affords the mind opportunities for profound thought and cogitation. Hence many invaluable suggestions have come from operators in the shop as a result of their intimate and expert association with the prime elements of their work. Young engineers, in particular, need to keep this in mind.1 Both groups are definitely essential to any manufacturing organization and their individual characteristics should be recognized and fairly evaluated. Neither group is superior to the other in importance to the company for both have their purposes and value.

Actually all engineers are not as creative or progressive as they should be and neither are all machine operators as reluctant to accept changes as has been implied in this analysis. Foremen and other supervisory shop staff members generally are aware of the values and benefits of wholesome change but many, notwithstanding, are continually tempted to "leave well enough alone" in the face of the average worker's reaction to change. Since it is the foreman or supervisor with whom the engineer ordinarily deals, this difference in viewpoint is less serious than if he were to work directly with the machine operators themselves. Nevertheless, worker attitude has proved to be a potent factor in all industrial relations and must be understood and considered in all engineering-shop contacts.

#### Importance of Understanding

Tolerance, sympathy and understanding of the other fellow's aspect of the problem at hand furnish the key to more harmonious and effective co-ordination in engineering-shop relations as in any other field of human contact. Insofar as understanding is concerned in the engineer's point of view, he will do well to keep in mind that factory workers as a group, as revealed by an Elmo Roper poll, find less satisfaction and outlet for self expression in their jobs than do the professional and executive groups and consequently deserve a more tolerant and patient approach than they are often accorded.

How can the shop man be educated to look more favorably upon change? The answer is two-fold: (1) Show him how past changes have helped him as an individual worker and as a part of the organizationand (2) give him a part in making future changes. All major changes in method, design, etc., should be followed up by a study and a simple report to emphasize all advantages brought about by the change. Disadvantages might be evaluated as a basis for developing further improvements. Advantages may be classed as those which improve working conditions and those which improve customer satisfaction and production economy. The former benefit the workers directly, the latter indirectly by improving the company's competitive position and hence the worker's employment security. Whether this information is conveyed by means of written reports or through meetings of the personnel concerned depends upon the individual organization.

1 References are tabulated at end of article.



"... must understand the characteristics and limitations of the various production processes . . ."

Official V. S. Navy Photograph

Bulletins and written reports are at best only poor substitutes for personal meetings. Small group meet-



HAROLD A. BOLZ has more or less made a hobby of the study of personnel problems and professional engineering relationships. His down-toearth findings and conclusions have been published in numerous prominent engineering, management and personnel journals. As head of the General Engineering department at Purdue his supervision covers industrial engineering and management, manufactur-

ing processes and shops, and engineering drawing and descriptive geometry. His experience in industry and close collaboration with top industrialists in placement of graduates has helped to bring into sharp focus many of the obscure but highly important factors which make for optimum management-engineering-shop relationships. Formerly associate professor of mechanical engineering, Prof. Bolz has also made numerous contributions to the technical literature on machine design. He is a registered professional engineer and a member of ASME, AAAS, AAUP, and ASEE.

ings where men stimulate each other's thinking by their own comments are fine morale builders when properly conducted and can release a wealth of latent ideas. Whenever possible, the machine operators and plant personnel concerned should be invited to these meetings for it is their interest which is solicited. Such meetings are difficult to schedule and are time consuming; nevertheless they may be made to pay off handsomely in terms of enhanced employee morale and of productive ideas produced. Shop men who understand the benefits brought about by past changes and who have a part in initiating and perfecting new changes will gradually accept changes as a normal factor in the improvement of their own lot.

A GUIDE FOR CO-ORDINATION: The problem of securing co-operation and a harmonious working relationship between the engineering department and the shop has certain elements which are common to human-relations problems in all areas of activity. Inasmuch as human beings are, in many respects, much the same across all strata of our society, many personal considerations involved in their relationship are common to all groups which are obliged to work together. These personal or human factors can be defined rather readily. In regard to the area of human activity covered by this article there are certain technical factors which probably are peculiar to this area. These technical matters or techniques likewise can be defined and brought out into the light for study and consideration to give what we might call a guide to the development of successful co-operation between the engineers and production staff in a manufacturing organization.

Human Relations: Any organization, however great and complex it may be, depends for its success upon basic man-to-man relationships. If this assumption is correct, it is clear that the same elements of tact, fairness, courtesy, sincerity, respect, congeniality, dependability and awareness of the other person's point of view which govern all personal relations must be observed in the negotiations which are carried on between the engineering department and the shop.

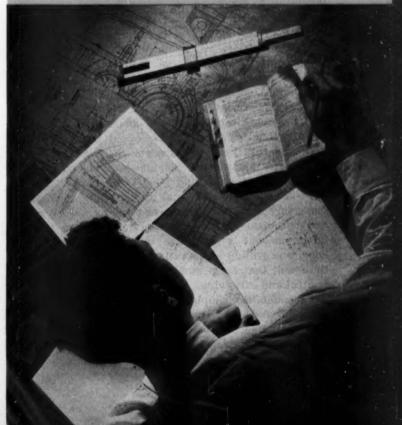
Tact requires delicate consideration and sympathetic perception of the other person's feelings. "What do you think about this idea?" promotes a receptive mood in the person being addressed, whereas "We have decided to do it this way" invites critical reaction and resistance.

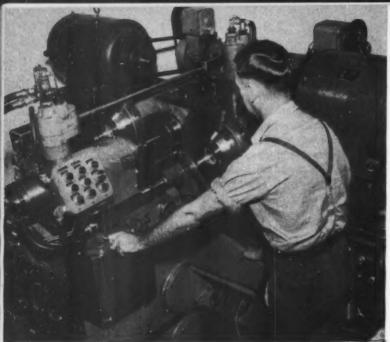
Fairness means giving credit where credit is due and requires honest, unbiased and conscientious square dealing in all matters. The engineer who appropriates ideas contributed by someone in the shop and then presents these ideas as his own without properly acknowledging the source is committing the worst violation of fairness because by implication he presents another's ideas as his own. The wages of unfairness are suspicion, distrust, and resentment which are the greatest of all deterrents to co-ordination.

Courtesy, sincerity and respect necessarily go together for courtesy without sincerity becomes hollow flattery, courtesy without respect might imply con-

> "...drawings, specifications and instructions must be prepared carefully ... so as to be perfectly clear and readily understood ..."

> > Photo, courtesy Falk Corp.





Photo, courtesy Gisholt Machine Ca

"... It might be well for engineers to bear in mind the fact that they depend rather heavily upon shop workers for data on machine performance, tool behavior, methods..."

descension, and respect without sincerity is meaningless. And it is probably true that "Please", "Thank you", "Excuse me" etc., can be used to excess in some shop groups. Again, young engineers sometimes associate the rough language and relatively dirty environment of certain shop areas with rough and uncouth manners and mistakenly assume the latter to be appropriate when dealing with shop men. This is a grave error in judgment since all persons respond favorably to courteous treatment discreetly and sincerely offered and shop men are no exception.

Since a ready smile, a cheerful air and an optimistic outlook contribute so much to the development of friendly and productive relationships, congeniality may be considered as a key consideration in human relations. Joe Smith, the Gloomy Gus of the engineering department, wondered why he could never get anywhere with the boys in the shop. As a matter of fact his habitual complaining about company practices and his chronic pessimism about business and world conditions seemed to infect everyone with whom he dealt, smothering any good ideas that they may have been able to offer and discouraging them from doing any further constructive thinking. Good cheer and optimism on his part would have been just as infectious but would have elicited encouragement, hope, and willing co-operation in place of gloom with the result that his personal contacts would have been fruitful and satisfying.

Dependability, implying promptness, punctuality, accuracy and integrity, is one of the strongest bonds that can be used in building a sound human relations structure. Dependable Dave does what he says he will do and is supposed to do—as it should be done

and when it should be done. Dependability means not only doing what you said you would do when and how you said you would do it; it means doing whatever you are expected to do by reason of your job responsibility and doing it as and when it is supposed to be done. The engineer who checked a certain fixture which he saw was causing trouble and had it corrected before the operator raised a fuss won the respect of that operator immediately. The result was that together they were able to work out an improvement that yielded great savings and brought recognition to both of them.

Although the factor of awareness of the other's point of view has been listed as a separate consideration, it is obvious that all factors previously mentioned depend upon this important one. In fact this one, which really epitomizes the Golden Rule, is The Law as far as all human relations are concerned. It embodies the individual approach which has become so important in our complex and increasingly impersonalized industrial structures. It demands that one know the person with whom he is dealing-know him personally, understand him, understand some of the motivations which drive him or the fears which inhibit him. One's immediate reaction to this, however, would be that no engineer has time to make friends with every individual with whom he has to deal in the shop, at least not to the extent that has been implied in this discussion. This may be true, of course, but since it is usually attitude rather than acts alone which govern the nature of dealings between individuals, it is essential that these personal and human considerations not only be understood but be considered seriously and be put into practice whenever possible. The engineer who learned that the experimental tool room foreman wrote poetry as a hobby always had an avenue of approach to get that occasional rush job done in the tool room. That foreman always seemed to find time to help the fellow who admired poets, even though they might be amateurs.

#### Values in Shop Man's Ideas

In pondering over these matters it might be well for engineers to bear in mind the fact that they depend rather heavily upon shop workers for their source of data on machine performance, tool behavior, methods, etc. The operator lives with his machine, so to speak, learns to understand its peculiarities and advantages and in some instances becomes a virtual library of experience and a storehouse of ideas. Many of these ideas are latent and will never come to life without proper stimulation. Others are active and alive but will never be expressed without proper encouragement. The engineer, consequently, is in a position to supplement his own background of knowledge and experience if he develops the techniques of encouraging workers to express their ideas. This means that he must not only understand the shop man's attitudes and his problems but also his "shop dialect". No worker will contribute information willingly and wholeheartedly unless he feels that he is a part of the organization that is going to use this material for his benefit as well as for the benefit of the company. While the engineer must solve the problem of developing the kind of man-to-man relationship that will bring this co-operation into effect, the management of his organization must recognize the fact that there is a limit to what can be accomplished through personal dealings between individuals alone. Management should lend its support through an organized procedure of recognizing and rewarding worthwhile suggestions and contributions of constructive and creative ideas and should give the engineer a prominent part in judging such suggestions.

#### Importance of Specifications

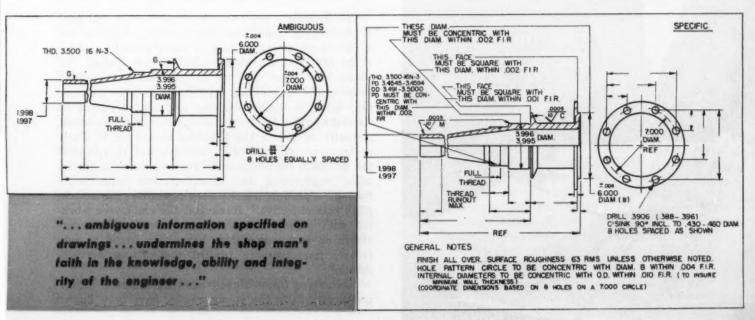
COMMUNICATIONS: One of the critical links in the chain of personnel and industrial relations is that of communication. An individual may be motivated by the highest ideals of personal conduct toward his associates and management may likewise operate under the highest type of personnel policy; however, if explanations, orders, requests, and instructions are not made clearly, definitely, and in keeping with the principles of tact, courtesy, fairness, sincerity and dependability, misunderstanding may develop and ill will, latent or active, may be engendered where nothing but good will was intended.

Specifications: One of the major impediments to engineers in gaining the confidence of shop men arises from ambiguous information specified on drawings. Such notes as "cut to suit", "weld", "drill to fit part so-and-so", "finish for slide fit", etc., in lieu of specifying tolerances and finishes and making other definite instructions on drawings undermines the shop man's faith in the knowledge, ability and integrity of the engineer who is responsible for the drawings. When the engineer assumes the right of specifying designs he must accept the responsibility for making decisions as to fits, finishes and other details vital to the satisfactory performance of the part. To pass incomplete or ambiguous information to the shop shifts the burden of these decisions to the shop. This is either a form of "buck passing" or a display of carelessness, irresponsibility or incompetence—in any case detrimental to sound co-ordination and wholesome personnel relations.

APPLICABLE TECHNIQUES: Although these general principles governing human relations as applied to the associations between engineering and shop personnel are fairly simple it might be well to consider some of the specific techniques which are applicable in this particular relationship. Attitudes, again, are of paramount importance, for it is often possible to get good results using rather poor human relations techniques solely by reason of the ingenuous nature of the person so doing. In a complex industrial organization, however, too much is at stake to depend upon anything but the soundest of techniques, examples of which may be enumerated as follows.

Direct Work Through Designated Organization Channels: This might be labeled as the prime technique of all. Cutting under a foreman weakens his position, confuses his men and establishes serious barriers to subsequent negotiations. Following prescribed organization lines and "building up" the supervisor to his men strengthens the confidence of employees in their departmental management and in their superiors and in turn yields stronger support to those dealing with that department. The purpose of this discussion is not to specify any particular type of organization. The structure itself is not as important as is the fact that some specific organizational structure must be defined and that that structure then must be respected and followed. If it is a sound working structure it will avoid overlapping responsibility and authority and will impose no responsibility without granting corresponding authority.

Systematize Plant Visits by Engineers: Regardless of the specific nature of the organizational pattern it is necessary for certain engineers in every company to make frequent visits to the plant. This practice is a potential source of trouble and should be controlled and systematized to give the best results. Not only is it possible for plant visitations to consume an excessive amount of engineering time but such



visits also contribute toward the distraction of the manufacturing staff with resultant loss of production. Furthermore, these visits may inspire a certain feeling of resentment on the part of the shop staff who ordinarily are less free to roam and seldom enjoy the privilege of visiting the engineering department facilities. Some organizations handle this problem by the technique of designating specific liaison engineers to deal with the shop staff and require others to secure special passes or to register for trips to the plant. This plan places plant visits on an orderly basis, minimizes time killing, and promotes the respect which naturally develops for any efficient and well orgaized group. Furthermore, it is well to conduct as much of the co-operative business between departments through regularly scheduled meetings as is possible and to reduce impromptu visits to a minimum. The use of the telephone and of written communications also serves to expedite negotiations between departments.

At this point, however, it must be recognized that individual personal contact is a wholesome thing for plant morale and certainly should never be discour-

"...paper properly designed, co-ordinated and handled can contribute greatly to efficient operation..."

Photo, courtesy Reliance Bloctric & Engineering Co.



aged. The foregoing suggestions are offered only as means of controlling and systematizing interdepartmental visits and are definitely not meant to imply that such visits could or should be prohibited nor that engineers should be cloistered or isolated from shop influences. That organization which discourages the personal touch—the friendly approach and the mutual understanding which results from the informality of face-to-face conversation—sacrifices that great source of strength which comes through the joint efforts of men who are willing to work together to make things go when the prospects of success are weakest. In fact it might be very desirable in many organizations to establish a regular program of personal shop contacts carefully planned, properly timed and diplomatically developed by certain key engineers selected for their natural skill and tact in handling such matters. Since there is no satisfactory substitute for wholesome personal contact in any phase of industrial relations such a planned program might serve as a means of establishing a sound pattern of personal contacts which might ultimately be adopted by all personnel involved.

Secure Proper Approval Before Making Changes: There probably is no phase of activity that causes more severe strain on engineering-shop relations than does the improper initiating and handling of engineering changes. Changes in design, materials, tolerances, scheduling, routing, processing, etc., ordered by the engineering department certainly must have prior approval of those persons responsible for maintaining production under the changed condition. Even when a change is sound and wise we know that "the shop" will react against it unless they have had a part in establishing it in the first place. A systematic procedure under the co-ordination of a liaison engineer, including proper shop representation for planning and processing of changes, will contribute much toward improving the nature of the changes themselves and of insuring their wholehearted reception by the shop.2, 8

#### **Product Development Committees**

The incidental effect which such a system will have in developing more wholesome feelings between the departments concerned may, in many situations, prove to be the most significant effect of the system. Of course, the same type of co-operation is necessary between the engineering department and the purchasing, sales, methods, planning and cost departments depending upon the nature of the changes themselves. Actually, of course, the objective should not be solely to improve the quality of changes but to minimize the necessity for changes. Proper co-ordination among sales, engineering and manufacturing departments through a product development committee can accomplish this objective.4 Rank and file employees working with engineers, salesmen and production supervisors on such committees have been found to contribute immeasurably toward cost-cutting developments.5

Understand Union-Management Agreements: Engineers, especially the younger ones, have been known

to cause considerable trouble for themselves in their dealings with the shop staff through their lack of familiarity with, and in many cases downright ignorance of, the contract provisions governing the relationship between the union workers and the management. Inasmuch as the work of engineers often brings them into direct contact with the machine operators themselves as well as their work it is essential that both parties, in order to understand fully each other's point of view, certainly must be familiar with the regulations and the which each is employed. The chances are that a st union members will usually understand the engineers of the converse is not true.

#### Effect of abor Agreements

Inasmuch as labor greements not only influence personal behavior of employees but also affect working conditions, methods, materials, sequence of operations, etc., the engineer cannot do properly his work of designing, planning co-ordinating and controlling products and production without a thorough familiarity with pertinent provisions and restrictions. The wide variety of tasks assigned to engineers in most industrial organizations makes it difficult to determine the extent to which labor-relations training should be given to the engineering staff. For best results this should be part of every engineer's background and he should be kept up to date by management on all current developments in this respect. The importance of this point cannot be too strongly emphasized if it is accepted that the individual approach and the personal man-to-man contact previously discussed are important in the maintenance of sound and effective relationships between the engineering department and the shop or manufacturing staff.

Maintain Distinction Between Engineering and Shop Work: In general it is not advisable to require members of the engineering staff to perform ordinary shop operations which might be involved in the completion of a project carried out under their supervision. Shop operations require definite skills for satisfactory execution. Engineers, as a rule, do not possess these skills to an acceptable degree of competency, Granted, however, that some engineers may possess satisfactory manual skills, their time generally may be much more effectively applied to creative and analytical functions. To encourage or require engineers to do certain shop work as a regular part of the performance of their engineering duties lowers their prestige as professionally trained men and infringes upon some of the prerogatives of the shop staff.

Admittedly it is important that the engineer be capable of operating the machine which he has designed. Furthermore, it enhances the engineer's reputation in the plant to be able to demonstrate occasionally that he can handle production equipment, but his prestige suffers if he is expected to continue such operations as a regular part of his work. In many plants regulations definitely prohibit engineers from performing the tasks normally assigned to mechanics, machinists and operators. In plants where such regulations are not in effect it will nevertheless be found



Photo, courtesy Lyons Metal Products Inc.

"...co-ordination among sales, engineering and manufacturing departments through a product development committee can accomplish this objective..."

desirable to limit the performance by engineers of functions and services ordinarily ascribed to members of the manufacturing and production staff.

Shop workers like to feel that they possess definite and peculiar skills. Even though an enginer may possess a certain skill in a degree comparable to that of a production worker with whom he must associate there is a real question as to whether by demonstrating his skill he will gain more in respect than he might lose by having deprived the worker of his own feeling of superiority. As in all human relations this is a question which can be answered only in the light of all personal factors involved in the specific case at hand.<sup>6</sup>

Use "Paper" Effectively: The greatest mechanical aid for expediting relations between the engineering department and the plant or manufacturing department is paper. The term "paper" as generally used in this connection includes the various records, orders, requisitions, bills of materials, drawings, notices, requests, reports, inquiries, schedules, etc., which serve as means of communicating and recording the vast amount of detailed information required in the production of industrial products. Such pieces of paper properly designed, co-ordinated and handled can contribute greatly to the efficient operation of an industrial organization. On the other hand, however, records, figures, statistics and reports have a great fascination for certain types of minds and extreme vigilance and precaution must be exercised to keep the paper system itself efficient, to eliminate unnecessary steps, useless records and worthless reports from gradually developing like a parasitic growth sapping the strength and vitality of an otherwise normal and healthy system.

In order to establish a system of records and communications on an efficient basis and to maintain it on a sound basis, it is necessary that the primary



Photo, courtesy Glonn L. Martin Co.

"...engineering is by its very nature creative . . . engineers are expected to be original, inventive, ready to initiate, quick to abandon one idea in preference to a better one, and always alert to the potentialities of suggestions, criticisms and "wild ideas" . . . "

purposes of such a system be understood. These purposes may be outlined as follows:

- 1. To standardize and systematize communication and recording procedure
- 2. To standardize and define terminology, nomenclature, units and methods employed in the organiza-
- 3. To save time and effort in communication, planning, scheduling, analysis, accounting, etc.
- 4. To minimize errors in communicating and recording information
- 5. To provide lasting, convenient and accurate records for later reference
- 6. To expedite procurement and handling of materials
- 7. To minimize the amount of computing, estimating, designing, specifying, etc., required of workers whose jobs otherwise do not involve the exercise of judgment and skill in mathematical or analytical thinking.7

These objectives cannot be satisfied by a paper system that is not thoroughly planned and carefully designed. Every record, every report, requisition, order etc., must be individually designed so that it will have exactly the information which it is intended to convey with no unnecessary information and no repetition. It should be designed so that it not only will carry the proper information but will be arranged so that these data may be recorded and transcribed with a minimum amount of effort and motion considering whether it is to be typed or filled out by hand.8

A record should be designed to be conducive to accuracy not only in recording but also in reading and transcribing. It should have the necessary qualities of durability, ease of handling, etc. The sizes and proportions of the individual pieces of paper used in any system should be selected carefully, keeping in mind such factors as standardization and uniformity, convenience in handling and filing, adequate space to allow legible and accurate entries, and economy.

These rather mechanical considerations might seem somewhat insignificant to be brought into a discussion of this sort. However, it is certainly true that just as properly designed and handled records and communications may greatly increase the efficiency of an operating organization so can a poor system greatly reduce efficiency and, more important, become irritating, fatiguing and annoying to the user.

#### There Are No Human-Relations Slide Rules

In discussing with engineers a subject such as coordination there is a danger in overemphasizing specific methods and techniques to be applied like formulas to particular cases as they arise. It is well to bear in mind in all considerations of problems involving human relations that it is the individual who is usually the basis or the nucleus of the problem and that as an individual he must be dealt with in the light of his own peculiar characteristics. Sound company policies and clear-cut standard procedures concerning the development and maintenance of the type of co-ordination and co-operation outlined herein are important but it must be emphasized again that successful industrial relations in the last analysis depend upon successful relations between individuals concerned.

Policy and standard procedures should be designed so as to facilitate and encourage sound human relations performance by all personnel. Individual human beings cannot be handled by the slide-rule methods of engineers for no slide rule or formula can possibly include all of the variables encountered. Rules and regulations themselves often produce harmful reactions, especially when tactlessly imposed or when unreasonably numerous or petty.9 Through proper analysis of and approach to the human as well as the technical factors mentioned in this discussion co-ordination between engineering and shop can become one of the most potent of all forces working for industrial progress.

#### REFERENCES

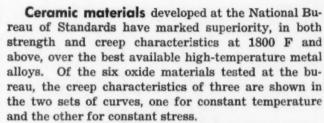
- 1. Douglas R. Lewis-"Mechanical Seals", MACHINE DESIGN, Nov. 1946, Page 182.
- James E. Thompson—"Engineering Management Fundamentals Adapted to the Small Company", Product Engineering, Oct. 1946.
- A. C. Wedge—"Drawing-Change System", Machine Design, March 1947.
- 4. Charles R. Sutherland-"A Plan for Engineering Accomplishment", MACHINE DESIGN, Sept. 1948.
- 5. "Labor Can Help You Cut Costs", Business Week, June 11, 1949. Pages 64-70.
- 6. H. A. Bolz-"A Design for Morale in the Engineering Department", MACHINE DESIGN, Aug. 1948.
- 7. Russel I. Haywood-"Engineering Record System", MACHINE DE-SIGN, Nov. 1946.
- 8. M. E. Mundel-"Saving the Typist's Time", Factory, July 1944.
- Clarence L. Pfeiffer—"A More Effective Drafting Room", Machine Drsign, July 1949.

## SCANNING the Field For

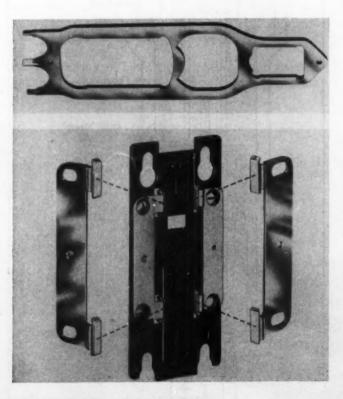
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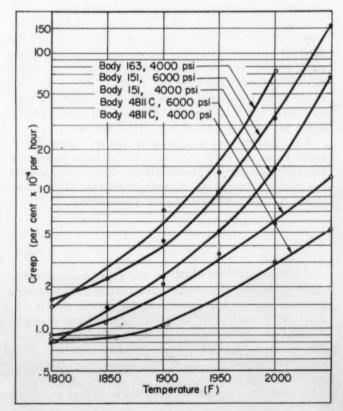
Sapphire inserts on the film shuttle and film side guides, below, for motion picture projectors eliminate difficulties caused by uneven rates of wear on the intricate mechanism and increase the normal wear life of the unit by approximately 400 per cent. In addition, the inserts increase normal film life. On the cam-actuated shuttle the insert acts as the actual contact finger which engages the sprocket holes in the film to place a new frame before the projection aperture 24 times each second. Due to the high abrasive nature of film, shuttles with hardened steel fingers will wear sufficiently to interfere with smooth operation, causing film damage in about 250 hours of operation. Sapphire fingers, however, show no appreciable wear after 1200 hours, equivalent to more than 100 million cycles.

Side guides of chromium plated steel, subjected to continual wear as they bear on the edge of the film under spring pressure, normally wear out in approximately 500 hours in providing the necessary braking action to stop the film briefly 24 times a second. Sapphire guides continue to function efficiently, showing no wear, after 2000 hours. These special inserts were developed by the DeVry Corp., manufacturer of projectors, and the Industrial Products division of the Elgin National Watch Co., fabricators of sapphire.

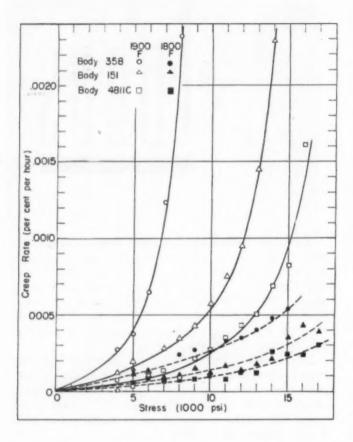


In the tests, each combination of stress and temperature was maintained for about 160 hours. Conditions were then changed by an increment of either stress or temperature, until failure, for a total of 109 tests. Strengths in tension up to 18,000 psi at 1800 F and 15,000 psi at 1900 F were observed. Above









1900 F, however, the strengths drop off rapidly to an average of about 5000 psi at 2000 to 2200 F.

Resistance to creep also decreases rapidly when temperatures are raised above the range of 1800 to 1900 F (curves above). Maximum observed creep rates for all the porcelain bodies tested range from 0.0001 to 0.0002 per cent per hour at 1700 F for the range of stresses used; from 0.0002 to 0.0008 per cent at 1800 F and a ctress of 16,000 psi, and from 0.003 to 0.004 per cent at 1900 F and 10,000 psi stress.

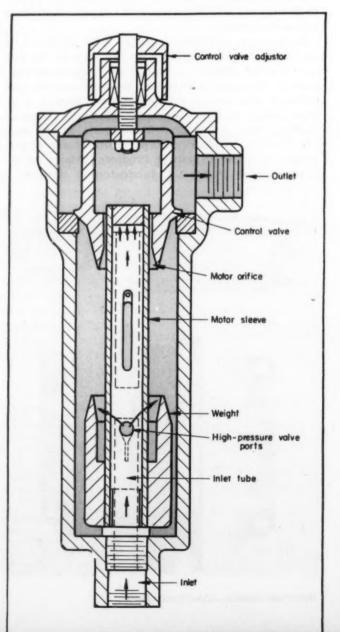
An experimental gas turbine, using blades fabricated from the oxide material of the most promising strength and creep characteristics, has been operated successfully in the Cleveland laboratory of the National Advisory Committee for Aeronautics.

Pressure differential in the regulator shown at right maintains adjustable, constant fluid flow which is independent of pressure. Designed by the W. A. Kates Co., the regulator has its differential pressure element in the center of a valve disk and is so arranged that the differential element regulates both the pressure across itself and across the surrounding valve disk.

Fluid from the inlet at the bottom enters a central

vertical tube and flows through high-pressure valve ports into the low-pressure part of the casing. From there it flows through the motor orifice. Being restricted, this flow sets up a pressure differential between the low-pressure and the outlet portions of the casing. This differential tends to lift the motor sleeve and attached weight. Because the inlet tube is stationary, the high-pressure valve tends to close as the motor sleeve lifts. When the upward force of the pressure differential equals the pull of gravity on the motor sleeve mass, the motor sleeve will come to rest. For any particular combination of orifice and fluid, the pressure differential is determined by the volumetric flow.

If fluid is shunted through the control valve to the outlet, the motor will still maintain a constant pressure differential across its orifice and a constant flow through it by operation of the high-pressure valve. Flow through the control valve will also be constant, and the sum of the two component flows will be constant regardless of variations in inlet pressure, outlet pressure or both. A control valve knob at top of unit provides adjustment of total flow through the regulator by varying the opening of the control valve.



### Determining

By Werner I. Senger

Manager

Balancing Machine Division

Gisholt Machine Co.

Madison, Wis.

## BALANCING

Accuracy

By a series of tests, the balancing accuracy of both static and dynamic balancers can be readily determined to arrive at the practical specifications which can be used for machine parts to be balanced in production

SE of balancing machines to measure and locate static and dynamic unbalance in rotating bodies is assuming greater importance as design for higher speeds progresses. Balancing machines are available in a variety of types, sizes and accuracies. Generally, it is easy to select the proper type and size machine for a given job or jobs. However, it is generally difficult for a purchaser of a balancing machine to determine the accuracy of balance required for his work and it is still more difficult for the buyer to assure himself that the balancing machine selected will measure unbalance to the required order of accuracy.

The balancing of rotating bodies is undertaken as a precision operation, Fig. 1. Therefore measurements

must be made with a precision device. It is just as reasonable to provide an operator with an insensitive balancing machine and then expect perfect results as it is to provide the operator of a cylindrical grinding machine with a wooden yard stick and expect him to measure diameter to accuracies of 0.0001 or even 0.001-inch. It is therefore desirable that some simple means be provided whereby the required accuracy and also quality of work produced on a balancing machine may be readily determined.

MACHINES AND PRINCIPLES: There are two general types of balancing machines: (1) Static and (2) dynamic. A static balancing machine, Fig. 2, measures the displacement of the center of gravity of a body from the rotational axis of the body. Dynamic balanc-

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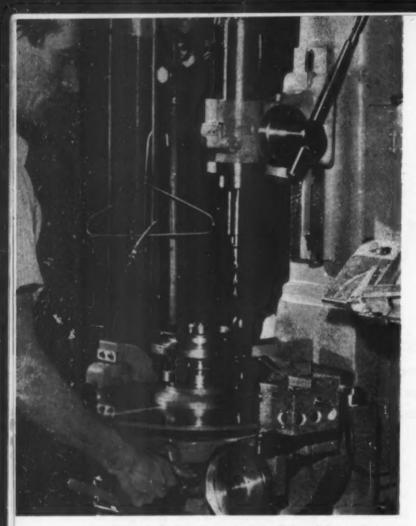


Fig. 2—Static balancers are generally used for measuring and correcting unbalance in disc-like parts such as the belt pulley and vibration damper assembly shown

ing machines measure the combined effect, at the bearings, of displacement of the center of gravity and displacement of the principal inertia axis from the rotational axis as determined by the bearing. These measurements are more readily understood by reference to Fig. 3, which is intended to reppresent any body which is to be balanced. The line ZZ represents the rotational axis as determined by the bearings supporting the body and cg' represents, the actual location of the center of gravity of the body before balancing. Line Z'Z' is parallel to ZZ through the center of gravity cg'. A static balancing machine measures the effect of the mass of the body displaced the distance e from the rotational axis.

In Fig. 3, Z''Z'' represents that principal inertia axis of the body which most nearly coincides with the rotational axis. This axis is inclined at an angle with respect to the rotational axis and, of course, the principal axis passes through the center of gravity cg'. When not restrained by bearings, the body will rotate about axis Z''Z'' and will cause a displacement p of the left-end bearing. Vibration due to unbalance is produced by the continual efforts of the body to rotate about axis Z''Z'' even though it may be restrained and forced to rotate about axis ZZ'. It is the purpose of a dynamic balancing machine to measure the displacement of Z''Z'' with respect to ZZ.

Balancing machines, then, measure displacement.

The formula for determining the displacement is approximately:

$$p = \frac{wr}{W} + \frac{wrhJ}{g(I_x - I_z)} \dots (1)$$

where w is a weight producing unbalance in the body, r is the distance from the rotational axis to the weight w, W is the weight of the body, h is the distance between a transverse plane containing w and a transverse plane containing the center of gravity, j is the distance from the center of the bearing to the center of gravity of the body as indicated in Fig. 3 and  $I_x$  and  $I_z$  are, respectively, the moments of inertia of the body about the XX and ZZ axes. This formula is developed in Part I of "Specifying Dynamic Balance" published in the November, 1944, issue of Machine Design.

This displacement formula may be rewritten as:

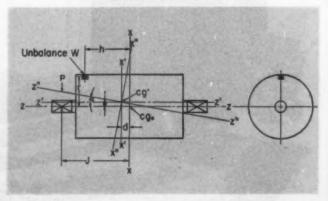
$$wr = \frac{pWg (I_x - I_z)}{g (I_x - I_z) + WhJ} = p \frac{Wg (I_x - I_z)}{g (I_x - I_z) + WhJ} (2)$$

If w is in ounces and r is in inches, unbalance can be read in ounce-inches and the unbalance so indicated is proportional to the bearing displacement p. So, by introducing unbalance effects in ounce-inch values, we can find means for checking the accuracy of a balancing machine. Before proceeding further, it should be noted from the formula that an unbalance which will produce a desired minimum bearing displacement p is a function of the weight W of the body, the moments of inertia of the body  $I_x$  and  $I_z$ , the distance h, and the distance J.

Equipment: The equipment required to determine the accuracy of a balancing machine is readily available. The radius at which unbalancing test weights are applied may be measured by use of a scale or may be determined from a drawing of the parts to be balanced. Simple test weights are also readily available. The weight of some easily available material is given in Table 1. It is necessary to provide special test weights for unusual jobs and where exact information is required as to the accuracy of balance. The exact weight of special test weights may be accurately determined on a chemist scales or on any other accurate scales.

In addition to the above equipment, it is desirable

Fig. 3—Diagram showing displacement of rotational axis resulting from dynamic unbalance



to have available some chewing gum, shellac or other material whereby the test weight may be attached to the workpiece while checking the balancing machine for accuracy.

REQUIREMENTS OF A STATIC BALANCER: It is essential that certain precautions be taken to insure that the balancing machine does not receive criticism for errors which are not assessable against the machine. Some errors may be due to the manufacturing tolerances permitted on the workpiece while others may be due to eccentricities in the adapter which locates the workpiece.

#### Support Surfaces Important

The surface or surfaces on the balancing machine which locate the workpiece must run true with respect to the bearings from which these surfaces receive their support in the balancing machine. When an arbor is used for supporting a workpiece for balancing on knife edges, Fig. 4, the locating surfaces are the diameter and face on the arbor by which location of the work is determined. The supporting surfaces are those diameters which actually rest on the knife edges. In the vertical type of static balancing machine, the locating surfaces are the diameter and face from which the work is located, Fig. 5. The supporting surfaces are the spindle bearing surfaces of the machine.

Runout of the locating surfaces with respect to the supporting surfaces can always be determined by means of a dial indicator using common inspection processes. Permissible runout can be determined from the following formula: Runout (total dial indicator reading) = desired balancing accuracy in ounceinches ÷ weight of the workpiece in ounces. If the runout (total indicator reading) exceeds the value determined from this formula, the unbalance in the work due to the runout will exceed one-half the established balancing tolerance. It is desirable that the runout be less than this value so that the balancing machine operator may easily balance to the desired tolerance.

Fig. 4-Typical arrangement for horizontal static balancing

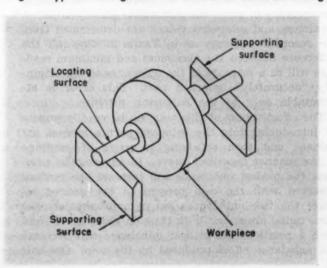
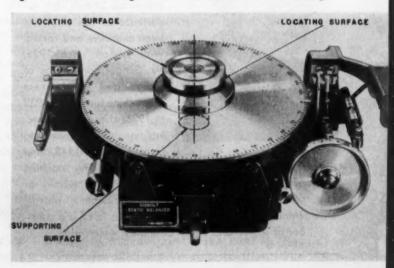


Table1—Test Weights for Balancing

"Five cent" piece A "Dime" A "Quarter dollar" A "Half dollar"  (Flexo Wax, Light, Type "Gand of the collar of the	Weight (Ounces)	Lack of Uniformity (Per cent Error)				
	Coins					
Copper "One cent" piece	0.109	2				
"Five cent" piece	0.175	2				
A "Dime"	0.087	136				
A "Quarter dollar"	0.219	1				
A "Half dollar"	0.435	1				
W	ax Balls					
(Flexo Wax, Light, Type "C"	' mfg. by	Glycol Pro	lucts Co. Inc.)			
%" diam. ball	0.00075	6	Note:			
A" diam. ball	0.0015	7	Do not use			
%" diam. ball	0.0057	8	where exact			
%" diam. ball	0.0468	9	answers are			
1" diam. ball	0.3114	10	required			
Mod	eling Clay	,				
%" diam, ball	0.001	6	Note:			
A" diam, ball	0.003	. 7	Do not use			
¾" diam. ball	0.008	8	where exact			
1/2" diam, ball	0.056	9	answers are			
1" diam, ball	0.400	10	required			
	ecl Rods					
0.125" diam, 0.125" long	0.007	1				
0.1875" diam, 0.1875" long	0.023	1				
0.250" diam, 0.250" long	0.055	1				
0.500" diam, 0.500" long	0.441	1				
0.375" diam, 0.375" long	0.185	1				

A second precaution is to use a workpiece which fits the locating surfaces perfectly. If there is play between the workpiece and the locating surfaces on the balancing machine, unbalance effects will be introduced which are not caused by inaccuracies in the balancing machine. Play between the workpiece and the locating surfaces of a static balancer can cause differences in unbalance measurements of a magnitude which can be determined by the following formula: Unbalance effect in ounce-inches = Weight of the workpiece in ounces x play between workpiece and locating surface in inches. Obviously, this play or freedom must be reduced to a value which can produce an unbalance effect considerably less than the balancing accuracy required of the machine. It is desirable that this error be less than one-fourth the accuracy desired of the machine. Having taken these pre-

Fig. 5-Machine designed for vertical static balancing



cautions, one is ready to fairly determine the accuracy of a static balancing machine. The part which snugly fits the locating surfaces of the balancing machine should be balanced to the utmost accuracy obtainable on the machine. This can be done by repeating the unbalance measuring and correcting operations until the unbalance indicating means on the machine show zero unbalance in the workpiece.

Checking for Repeatability: This test can be made by introducing an unbalance into the balanced workpiece by adding a known weight at a measured radius. The product of weight in ounces by the radius in inches should introduce an unbalance corresponding to approximately 100 per cent of the maximum unbalance readable on the balancing machine indicating device. This unbalance should be measured ten successive times without moving the work from its initial position with respect to the locating surfaces of the balancing machine and without changing the unbalance artificially introduced. Each such measurement should be taken carefully by following, in its entirety, the procedure normally used to measure the amount of unbalance. Any one of the ten readings so obtained should deviate from the average value by less than one-quarter of the guaranteed or desired accuracy tolerance if accumulations of errors are to be avoided.

#### Consecutive Tests for Repeatability

Similar tests for repeatability should be made with artificial unbalance effects approximately equal to 20, 40, 60 and 80 per cent of the maximum value readable on the machine. Any one reading should deviate from its corresponding average value by less than one-quarter of the guaranteed or desired accuracy tolerance if accumulations of errors are to be avoided.

Check for Ability to Measure a Known Unbalance:



WERNER I. SENGER is one of the outstanding authorities on balancing and balancing design. Having helped pioneer the development of balancing machines at Gisholt, his experience in this field has been extensive and varied. With Gisholt since 1925, Mr. Senger had charge of design and development of machine tools from 1932 to 1935, charge of balancing machine engineering from 1935 to 1943, and

since then has been manager of the balancing machine division. He has a BSME degree from the University of Wisconsin and a MSME from Yale, has a number of patents on machine tools and balancing machines, and is a mem-

ber of ASME and Army Ordnance Association.

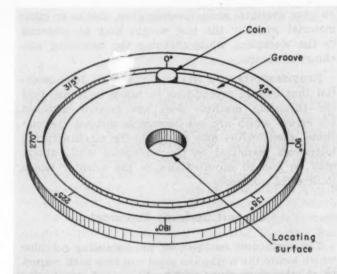


Fig. 6—Grooved workpiece used for making static unbalance tests

A groove exactly concentric with its locating surface should be turned in the workpiece, Fig. 6. The locating surface of the workpiece must be a good fit on the balancing machine. The precise radius to the center of the groove should be recorded. The width of the groove should be exactly the same as the diameter of a coin or test piece of known weight. It should be here noted that it may be necessary to prepare a special weight to properly check some types of parts. Eight equally spaced radial lines are then marked off on the groove and stamped 0 through 360 degrees by increments of 45 degrees.

In making this test, the unbalance introduced should be at least 30 per cent of the maximum possible machine reading and at least 20 times the balancing tolerance as read on the machine. Measure, by use of the normal process for measuring unbalance on the machine, and record the amount of unbalance indicated with the test weight at zero-degree position. This test is repeated with the test weight moved to positions marked 45, 90, 135, 180, 225, 270, and 315 degrees. If due allowance is made for the repeatability of machine readings, the variation in readings of amount of unbalance obtained at the several angular locations will provide means for determining the accuracy to which the part was originally balanced. Maximum and minimum values are determined from the recorded readings as in TABLE 2. One-half the difference between the maximum and minimum readings will be a measure of the unbalance in the originally "accurately" balanced part. This error is attributable only to the balancing machine.

The effectiveness of this test can be readily proven by introducing into the balanced part a modest unbalance and then obtaining a series of readings in the manner described above. In one angular position, the modest unbalance will increase the reading observed with the coin present in the groove because the two unbalances are in approximately the same radial direction. With the coin 180 degrees from such a position, the modest unbalance will decrease the unbalance effect produced by the coin. One-half

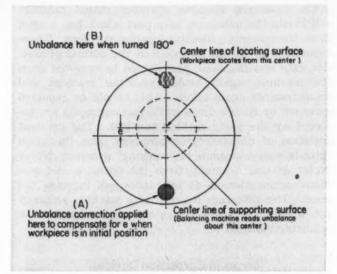


Fig. 7—Diagram showing determination of lack of concentricity of locating and supporting surfaces

the difference between the maximum and minimum readings will be the amount of the modest unbalance introduced.

This error inherently in the machine definitely establishes the accuracy to which the machine can be expected to read unbalance. This error should be less than one-fourth the desired balancing tolerance.

Checking Angular Accuracy of Machine: With the part modified as in Fig. 6 and balanced to maximum accuracy, introduce a known unbalance in the 0-degree direction. This unbalance should be at least 20 times the desired tolerance and more than 30 per cent of maximum machine reading. Measure and locate by the normal balancing procedure the angular position of the test weight. Apply at the indicated angular location a correction of the same type as was used for unbalancing the work piece. If the angular location is not 180 degrees from the angular position of the unbalance originally introduced, the angular error is the difference between the 180 degree position and the location indicated by the machine. The effect of this error in balancing machine units may be determined by measuring the unbalance remaining after application of the correction, Repetition of this test with the unbalance introduced at 45, 90, 135, 180, 215, 270, and 315-degree positions will give a complete picture as to the angular accuracy of the machine for all directions.

#### Importance of Angular Accuracy

It should be noted here that the angular accuracy of a balancing machine is important only to the extent that corrections of proper amount applied at the angular location indicated by the balancing machine can leave residual unbalance. The residual unbalance should not exceed one-half the desired machine accuracy in any test for angular accuracy.

Determining Machine Calibration: From the readings obtained in TABLE 2, machine calibration can be determined. It is obvious that the machine reading produced only by the coin or weight is 10.0, this

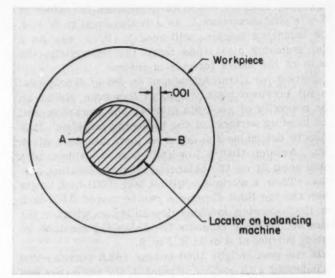


Fig. 8—Workpiece with clearance in bore introduces error which must be taken into consideration

being the average value of the recorded indications. This reading corresponds to an unbalance in ounce-inches represented by the product of the coin weight in ounces and the radius to the center of the groove into which coin was placed. By dividing the ounce-inches of coin unbalance by the machine reading, a factor is obtained which can be used as a multiplier to obtain unbalance in ounce-inches from machine readings. In determining machine calibration, it is always wise to use an unbalance effect which will produce a reading of at least 30 per cent of the maximum possible machine reading. With this multiplier available, errors observed in the preceding tests may be reduced to ounce-inch values.

#### Machine Provides Test for Concentricity

Test for Concentricity of Locating and Supporting Surfaces: A good balancing machine will in itself provide a means whereby the concentricity of locating and supporting surfaces may be determined. A workpiece which has a snug fit on the locating surface is measured for unbalance and corrected to the greatest possible accuracy. Rotate the workpiece 180 degrees with respect to the locating surface of the balancing machine and measure the unbalance. If an unbalance is observed, the lack of concentricity of the locating and supporting surfaces can be determined from the following: Unbalance in ounce-inches at 180-degree position = weight of workpiece in ounces × eccentricity (total indicator reading) of supporting and locating surfaces.

The accuracy of this statement may be determined by reference to Fig. 7. Assume the distance between the centerline of the locating surfaces and the centerline of the supporting surfaces is e. Then, a perfectly balanced part weighing W ounces would introduce an unbalance  $W \times e$  with respect to the supporting surfaces. This would be compensated for at A by the addition of a weight. When the work is turned 180 degrees with respect to the locating surface, correction A would appear at B position. The

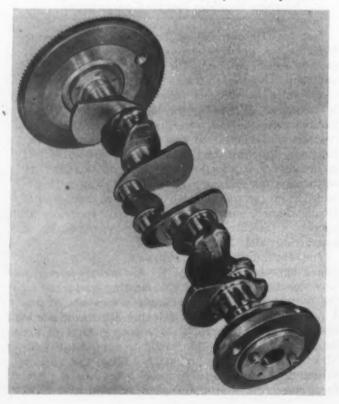
balancing machine would then measure the effect of  $W \times e$  plus correction A. As A is also equal to  $W \times e$ , the balancing machine will read  $2 (W \times e)$ . As a dial indicator also reads twice the eccentricty, the truth of the above formula is evident.

Testing for Error Introduced by Fit of Workpiece: In all previous tests, emphasis has been placed on the necessity of good fits between the workpiece and the locating surfaces of the balancing machine. It is wise to determine the effect of loose fits on a given job. Assume that a low-limit bore workpiece is a good snug fit on the balancing machine locating surface. Then, a workpiece with a bore 0.001-inch larger than the low-limit dimension can be moved 0.001-inch on the balancing machine depending on whether the bore of the work contacts the balancing machine locating surface at A or at B, Fig. 8.

If the part weighs 1000 ounces (62.5 pounds) and is balanced with contact at point A, the same part will be 1000 ounces  $\times$  0.001-inch or 1.0 ounce-inch out of balance when contact is at point B. Balance errors of this nature are not assessable against the balancing machine. They can be reduced only by control of manufacturing tolerances on the workpiece.

Checking Working Accuracy of Static Balancer: In most of the preceding tests, emphasis has been given to obtaining accurate readings. Unfortunately, production is often materially decreased if the balancing machine operator takes time to obtain accurate readings. Furthermore, in production, it is not reasonable to expect an operator to exercise the necessary care. It is wise, therefore, to determine a "working" accuracy for a machine.

Fig. 9—This rotating assembly from an automotive engine is corrected for dynamic balance by drilling at both ends. Holes can be seen in vibration damper and flywheel



The balancing machine operator should measure and locate the unbalance in a part which has a snug fit on the balancing machine locating surfaces. These measurements should be taken at the normal production rate and the same part should be removed from the machine, again loaded into the machine and measurements again taken. This should be repeated some ten or twelve times while measurements are recorded by the party making the test. The greatest deviation of unbalance measurement from the mean value is a good measure of "working" accuracy. Never expect greater accuracy from the operator and machine combination as fit tolerances will increase the error. The difference between true machine accuracy and working accuracy is not chargeable against the balancing machine.

#### **Errors in Correction Devices**

Accuracy of Correction: Balancing machines measure and locate the amount of unbalance correction required in a workpiece. Correction devices are often incorporated as integral parts of balancing machines. Failure of these devices to add or remove the indicated correction cannot be considered as an error in the balancing machine. Of course, correction errors do show up as an unbalance in the finished product. For a discussion of these errors, see "Specifying Dynamic Balance" in the January, 1945 edition of MACHINE DESIGN.

REQUIREMENTS OF DYNAMIC BALANCING MACHINE: It is well known that corrections for balance must be made in two planes to dynamically balance a rotating body, Fig. 9. See Part I of "Specifying Dynamic Balance" in the November, 1944 issue of MACHINE DESIGN for proof of this statement. These correction planes must be perpendicular to the rotational axis and must be spaced some distance apart. Their location is generally determined from limitations imposed by the design of the workpiece. It is the function of a dynamic balancing machine to determine the amount and angular location of correction weight to be added or removed at established radii in each of these planes. From these requirements it is possible to develop a series of tests for accuracy of dynamic balancing machines (two plane corrections).

While balancing machines do measure displacement, the amount of correction weight to add or remove is a function of the physical characteristics, mass and mass distribution of the workpiece as well as the displacement (Equations 1 and 2). Therefore, all tests for accuracy of a dynamic balancing machine are best made with a workpiece for which a given balancing accuracy is desired. Then, by computation it is possible to determine from Equation 1 the axis displacement, at the workpiece bearings, due to a given unbalance effect.

Precautions in Testing: The dynamic balancing machine should be carefully set up in accordance with the manufacturers' recommended practice. All driving devices, supporting bearings or rollers should meet the balancing machine manufacturers' specifications so that errors measured are truly errors chargeable to the balancing machine.

Check for Ability to Separate Unbalance Effects into Corrections Required in Two Selected Planes: It has been previously stated that a dynamic balancer should measure and locate the amount of material to add or remove, in each of two selected transverse planes in the workpiece, to give balance. It is therefore important that the unbalance indication in one plane be unaffected by unbalance in the other plane. To check the ability of a balancing machine to separate these unbalance effects, a workpiece should be carefully corrected for balance to the maximum accuracy obtainable on the machine. In one of the transverse planes of correction a weight should be added which will produce an unbalance effect at least 20 times the desired tolerance for balance in that plane or an unbalance which will give at least 30 per cent of maximum machine reading. Set the machine to read unbalance in the plane which does not contain the unbalance. The dynamic balancing machine should indicate zero unbalance for this condition. Practically, the unbalance indication should not exceed 2 per cent of the unbalance introduced.

This test should be repeated with unbalance introduced only in the plane not originally used. With the machine set to read unbalance in the plane not containing the unbalance, the machine should indicate not more than 2 per cent of the unbalance effect introduced.

For these tests, unbalance effects may be introduced by adding known weights from Table 1 at a known radius in the plane of correction. It may be necessary or desirable to provide special weights for some jobs.

Check for Errors Introduced by External Disturbances: With a workpiece mounted in the machine and with the machine arranged to indicate vibrations produced by unbalance in one plane of the workpiece, observe the unbalance indication with the driving motor stopped. A balancing machine is a vibration indicating device and some machines may give unbalance indications under this test. Such indications are due to vibrations coming into the machine from external sources and are a measure of errors which are present in every measurement taken on the machine. Obviously, the machine should show zero reading under these test conditions. This test should be repeated with the machine arranged to read unbalance in the other transverse plane.

#### Effect of Motor on Balance

Unbalance indications on the machine for each correction plane should also be noted when the driving motor is operated without being connected to the work spindle. Obviously, the machine indications under these test conditions will be due to vibration produced by the driving motor.

Check for Repeatability: Introduce an unbalance into one correction plane of the accurately balanced workpiece by adding a known weight at a measured radius. The unbalance should be of such magnitude as will cause the unbalance indicating device to give a full scale reading. Ten successive unbalance measurements should be then carefully taken and recorded.

The procedure normally used to determine the amount of unbalance should be carefully followed. Any one of these measurements should deviate from the mean value by less than one-fourth of the desired balancing accuracy. Similar tests for repetition should be made with artificial unbalance effects approximately equal to 20, 40, 60 and 80 per cent of the full scale value. These tests should be repeated with unbalance in the other plane of correction.

Check for Ability to Measure a Known Unbalance: This test is made separately for each plane of correction by adding a known weight to a balanced work-

Table 2-Record of Unbalance Readings

Angle at w balance is on the wor	placed	Amount of unbalance indicated by the balancing machine
0		10.1
45	* * * * * * * * * * * * * * * * * * * *	10.0
90		9.9
135	*************	., 9.8 (Min)
180		9.9
225		10.0
270	**************	10.1
315	***************************************	10.2 (Max)

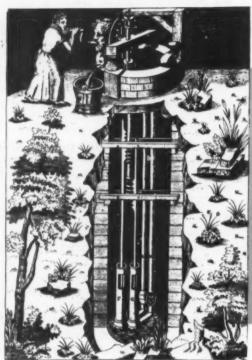
piece and measuring unbalance effects in the manner outlined for static machines. One-half the difference between the maximum and minimum readings in each plane of correction is a measure of the unbalance in the originally accurately balanced part. This machine error in each correction plane should be less than one-fourth the desired balancing tolerance in that plane.

Check for Angular Accuracy of Machine: This test should be made for each correction plane by introducing a known unbalance and following the test procedure described for static balancing machines. In each correction plane, the machine errors should not exceed one-half of the accuracy to which it is desired to correct for balance.

Determination of Machine Calibration: With the machine indications obtained in the above, the calibration can be determined for each plane of correction by the procedure described for static balancing.

Test for Working Accuracy: Using a similar type part, which is unbalanced, repeatedly determine and record the amount and location of unbalance in each plane of correction at the normal production rate. The maximum deviation of the indications from mean value is the working accuracy of the machine.

Test for Unbalance Introduced by Driving Means: After a workpiece has been accurately balanced, arrange to drive the workpiece when indexed 180 degrees with respect to its original angular location relative to the balancing machine driving mechanism. The amount of unbalance now observed in each plane of correction is twice the unbalance actually introduced by the driving means. This error may be due in part to attachment of the driving means to surfaces on the workpiece which are not concentric with the rotational axis. Errors remaining when the driver-locating surface is concentric are due to the driving means.



# Highlights in MACHINE

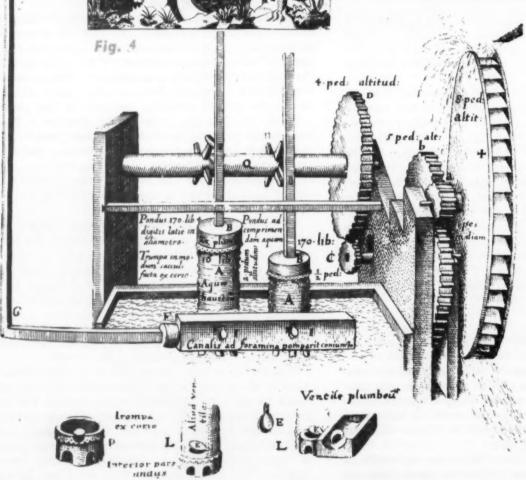


Fig. 3

China Contained to Village.

#### Part II—Reciprocating Pumps

## the History of HYDRAULICS

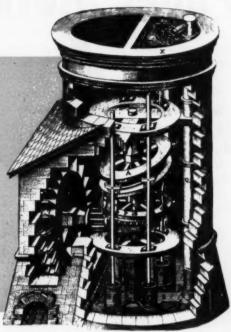


Fig. 5

R ECIPROCATING piston pumps operated by water wheels were evidently known to the ancient Egyptians long before the time of Christ. Bellows for blowing a fire are equally old and were used by the early Chinese.

A good example of the typical construction of early reciprocating pumps is illustrated in Fig. 3, from Robert Fludd's textbook of 1618. The cylinders are collapsible bellows carrying what the modern hydraulic engineer will immediately recognize as inlet and delivery valves, probably of leather. Reciprocation of the bellows, or pistons in the cylinders of earlier types, was effected by projections on a rotating shaft which alternately lifted and released the piston or bellows rods, as in the early type of drop hammer. The weight of the moving assemblies was employed to force the water up the delivery pipe. In the pump illustrated the main shaft is rotated by a water wheel and gear train, although many other means including human power, oxen, dogs or other animals were also used.

There are several early references to a famous water-operated piston pump built by the Roman Ctesibius about the time of Christ, to which had been fitted an air vessel or "accumulator" to smooth out the delivery and render it more or less continuous. There is no doubt that this improvement must have been of very considerable practical benefit but, due no doubt to the difficulties of recording invention and design before the introduction of printing, it appears to have been forgotten and was reinvented much later.

Ramelli in 1588 describes several types of reciprocating pump which even today appear of unusual merit. That shown in Fig. 4 has two cylinders, the pistons of which are reciprocated by reversing right and left-hand worms. It will be noted that the worm shaft has two pinions at its upper end which engage alternately with a half set of pin teeth on the wheel being turned by the operator, and which then rotate the worm shaft in alternate directions. This mechanism, a favorite of the ancients, is rare today—perhaps too rare.

What is probably the forerunner of all modern swash plate pumps is shown in Fig. 5. The swash plate mechanism itself was known at this time for clock escapements and the pump illustrated was probably devised by Ramelli himself although there is no evidence that it was ever built.

By H. G. Conway
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FOR many years the familiar two and one-half inch panel meter has been built to pretty much standard dimensions and style. Our model was hardly distinguishable from the same type meter produced by several companies. Competition has tended to reduce the price, but the twenty-year old design offered few opportunities for additional cost savings. Three years of experimental design with a larger model yielded results, production and saleswise, which strongly favored redesigning of the two and one half inch meter.

REDESIGN OBJECTIVES: Four principle requirements were listed as the primary objectives of the redesign, Fig. 2:

- 1. Better appearance for new sales appeal
- 2. All possible economies in production to meet the competitive condition of the market for this type and size of instrument
- Retainment of the same panel mounting dimensions for interchangeability in present designs of equipment where the meter might be used
- 4. Use of only those materials and methods that

have already been given a production test at one time or another in the plant to assure the greatest possible freedom from production bugs and performance defects.

OLD DESIGN: For the purpose of emphasizing the changes involved, a discussion of features of the old meter follows, Figs. 2 and 3. The case was made of front and back half pieces of compression-molded phenolic. Like most small panel meters the front half, or case section, had an opening into which a glass window was fitted. To make this dust and moisture proof, some form of putty or other sealing compound was used between the glass and the case, the glass being backed by a metal ring around the outside edge, for mechanical strength. Four screws insert-molded into the front half of the case provided for panel mounting, and three holes radially drilled around the barrel of the front half held the front and back, or base part, together. The base had all necessary projections molded-in to hold the meter movement as well as the terminal screws for electrical connections.

In this design, the scale mounting plate could be no larger than the inside diameter of the barrel of the case. This limited the usable scale space to less than half of the total front area of the meter. Because the scale was mounted behind a relatively small opening in the opaque case, it was difficult to read in a poor light.

NEW DESIGN: Of utmost importance in the redesign undertaking was the retention of mounting dimensions to make possible easy replacement of old meters. This has made it necessary to keep the same barrel diameter and the same location of panel mounting screws, Fig. 2. However, by making the barrel a part of the base, the scale mounting plate has been increased in size to approximately the full area of the meter front. Market research revealed that users of the meter had no objection to increasing the front dimensions slightly, provided the increase did not require a change in the panel mounting holes. By increasing the meter front from two and three-eighths inches square to two and seven-sixteenths inches, the scale arc has been made as large

as that used on the average three and one-half inch panel meter—a real sales advantage.

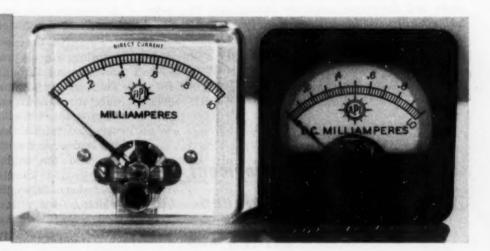
The front is molded of clear plastic for several important reasons. First, utilization of full scale area is possible. None of the scale plate is hidden or shadowed as in the old case. Second, reduction of the piece price for the same number of mold cavities can be attained because of the faster molding cycle. Also, in the matter of assembly, the slow and expensive fitting of the glass window has been eliminated by the clear, less easily broken plastic.

Experiments with several of the clear plastics indicated the most desirable results could be obtained with the new heat-resistant Styrenes. This plastic is readily molded free from flaws and has excellent transparency and dimensional stability at temperatures well above the meter design requirement of 150 F. It is slightly flexible, tough and not easily scratched.

The back part of the case is molded of the same

Fig. 1—Left—Snap hooks and recesses eliminate need for screws previously employed for fastening front and back case sections

Fig. 2—Right—Comparison views of the new and old designs. Larger scale area and lack of shadow are clearly evident



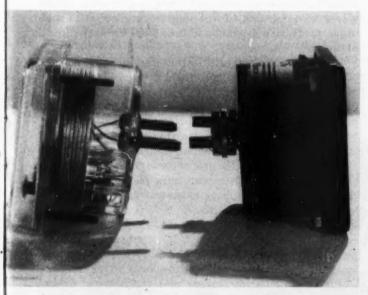


Fig. 3—Comparison views, new and old, illustrating the advantage, inspectionwise, of the clear plastic model. Also evident is the fact that both meters fit in the same panel mounting holes and have the same terminal stud location

material. By making the back transparent, inspection for defects which might have been hidden within the old opaque case is facilitated, Fig. 2. This feature also makes the meter adaptable to rear illumination by use of a translucent dial plate. Even though the outside dimensions of the barrel part of the case have not been increased, more space is available for mounting resistors, rectifiers, etc., because of the thinner wall section required in one-piece construction.

A study of production costs determined that the panel mounting screws should be hot-pressed into the finished case rather than insert-molded. So the mold is built to provide four holes, countersunk and slightly undersize, to take No. 4-40 flat-head screws.

The zero adjuster pin is held by a through-hole in the front case section. Previous experience had shown that it was difficult to mold such a hole in clear plastic without getting weld or flow lines where the material met after flowing around the hole core. Such lines detracted from the appearance of the case. Therefore, the counterbore is molded-in, but the through hole is drilled after molding.

An expensive operation in the old case was the fastening of the front and back case sections with the three radially located screws. To avoid this, snap

hooks and recesses are integrally molded into the case, Fig. 1. If a minor adjustment is required on a finished meter the front can be snapped off and replaced in much less time than was required on the old three-screw assembly.

Artists decided that some lines were required in the front to remove the plain appearance. It was felt, however, that the outside front surface should be kept smooth to make wiping clean easier. Both results have been attained by putting the lines on the inside of the front.

The terminal screws hold connection wires or components which must be soldered in place before assembly. For this reason these screws are held in molded recesses by Tinnerman speed nuts, Fig. 3, rather than being molded or hot pressed.

RESULTS OF REDESIGN: Results from the redesign have proved most gratifying. The appearance for new sales appeal is there. Several production economies have been realized by the change from compression to injection molding and by the elimination of several parts and expensive assembly operations. The new meter fits in the same panel mounting holes and requires the same space behind the panel. The usable dial plate area and scale arc length are more than doubled. Adherence to materials and methods that have been given thorough production tests has permitted production of the new design with practically no bugs.

## Professional Development of the Young Engineer

By J. C. McKeon and Guy Kleis
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INDUSTRY has a special responsibility in the professional development of the young engineer. When a college graduate joins a company, he is making an investment of his time and talents in that organization. His future welfare as well as his usefulness to the company will be determined, in a large measure, by the type of training and guidance he receives. Accordingly, the new recruit has a right to expect his company to make an investment in his training and development.

There are certain basic steps which the young engineer must take before he starts the second mile. You may call these steps preprofessional development, if you wish, but they are related significantly to ultimate success. A professional attitude, like happiness itself, is not something a person strives for, rather, it is a by-product of full participation in worth-while activities—productive labor, the family, and the community.

Too many companies are not giving adequate attention to preparing their people for technical and management positions. However, there is much that industry can do, especially for those who have a capacity for further growth. While individual company requirements vary, there are certain requisites for an effective development program which are worthy of discussion:

Create a proper environment. Effective development requires a favorable atmosphere in which to grow. One of the best ways to develop professional attitudes is through association with men, who, themselves, have a healthful outlook concerning the job, our social institutions, and life in general.

Selection and training. A company cannot long expect to maintain its position in the dynamic business world of today without making adequate provision for bringing in capable young men and developing them for key technical and management positions. Thorough training in fundamentals involves not only a clear understanding of the principles of science and the engineering method, but the capacity to apply them to the solution of everyday problems. But initial training of the more or less formalized type is not enough. There is need for continuous development on an informal basis as the engineer moves along in his career.

Educational opportunities. In addition to follow-up training, a good practice is that of encouraging selfdevelopment through courses at a nearby university. The engineer attains the status of a professional man only through experience and continued study. The importance of further study to enable him to recognize and handle the technical and human factors in his engineering work cannot be overstressed. Assuming that the engineer is reasonably well-grounded in scientific knowledge, and, therefore, is able to hold down an engineering job, the major problems which he will encounter will be problems of human and social relations. It would seem then, that the young engineer needs to deepen and broaden his social knowledge and to exercise the art of using it in the solution of everyday problems.

Encourage professional activities. Industry can do much to encourage technical employees to avail themselves of programs of the engineering societies and other professional groups and to take an active part in them.

One of the most fruitful areas for industry-college co-operation is through the inauguration of programs of graduate study for engineers who are engaged full-time in industry. While only the employer can provide orientation to industry and job training, teaching of advanced fundamentals can be handled best by colleges with the active assistance of industry.

The master keys to professional development are embodied in two words: encouragement and recognition. The young engineer needs encouragement if he is to use his abilities at the highest possible level and is to develop his potentialities through experience and education. A pat on the back for a job well-done and promotion for demonstrated ability acts as a powerful incentive to further self-advancement. Our responsibility as industrial leaders and engineering educators is to point the way.

<sup>\*</sup> This article is an abstract of a paper presented at the AIEE Winter General Meeting. New York, Feb. 1949 and published in *Electrical Engineering*, July 1949.

## Which Copper-Base Alloy?

By R. Carson Dalzell and Joseph J. Matt Revere Copper and Brass Inc. Rome, N. Y.

COPPER, one of the oldest metals known to man, has come a long way since the "Bronze Age" of ancient history. Because of its own inherent properties and its alloying qualities with zinc, tin, lead, silver, phosphorus, silicon, nickel, tellurium, arsenic and many other elements, it has shown the versatility necessary to keep in step with the progress made by man in the Machine Age. Its qualities are constantly being improved and expanded by research and experimentation so that today we have multitudinous applications wherein copper and its alloys give superior performance.

Copper and most of its alloys act like a pure metal. They are not heat-treatable—cannot be hardened by application of heat followed by a quench—nor do they become brittle at extremely low temperatures. Hardening is produced by cold working alone, which tends to give a large range of physical properties for each alloy. Softening is produced by annealing above the recrystallization temperature for the required time, but the effect of the rate of cooling after annealing is, with few exceptions, negligible. In most cases annealing is followed by a water quench in order to save time in processing. This property alone lends a great deal to the versatility of copper and its alloys.

Copper-base alloys have excellent ductility, tensile strength, elongation, electrical conductivity, thermal conductivity, and corrosion resistance. Desirable combinations of these properties are secured by selection of chemical composition, grain size and temper. These alloys are highly



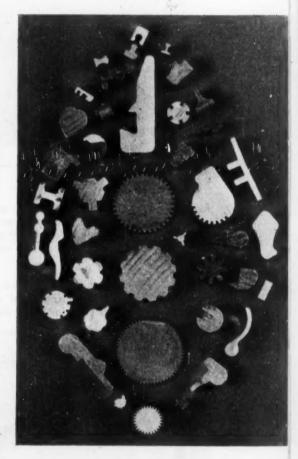


Fig. 1 — Copper-base alloys are available in tubing (left) and bar (above) extruded or drawn to an infinite variety of shapes to specification. Use of such shaped stock can often eliminate a great deal of expensive machining

machinable and are readily drawn, stamped, coined, forged, formed, spun, swaged, cold headed, soldered, brazed, and welded. The most commonly available forms of copper and copper alloys are sheet, strip, roll, rod, bar, plate, tube and extruded and drawn shapes.

Sheet, strip and roll forms of many of the alloys can be obtained in various tempers and finishes. The finishes may vary from embossed, crimped, dull, and satin, to bright dipped, or suitable for polishing or

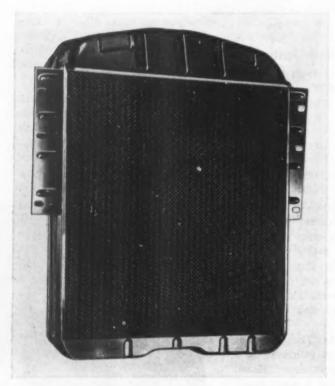
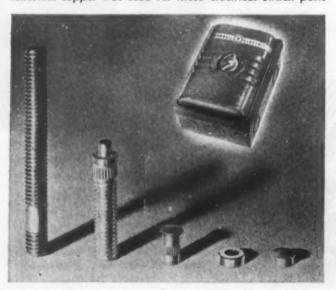


Fig. 2—Above—Silver-bearing copper was selected for this auto radiator because it is easily formed, has high thermal conductivity, is readily soldered without loss of strength, and has good corrosion resistance

Fig. 3—Below—Because of its high conductivity, corrosion resistance, ease of machining, and moderate strength, tellurium copper was used for these electrical switch ports



plating. Physical-property ranges vary for the different alloys but all are based on a temper nomenclature of grain size for soft material, and 1/4-hard, 1/2hard, etc., for the hardened condition. Grain size determines the fundamental properties of ductility and tenacity, and also the important attribute of smoothness of surface after drawing. An increasing grain size causes an increase in ductility, a decrease in tenacity, hardness, and the rate of work hardening, and an increase in the roughness of the drawn parts. The converse is equally true. In general, it is desirable to use strip having the smallest grain size which will give sufficient ductility to enable the desired shape to be produced with a fair margin of safety. TABLE 1 shows the common tempers for sheet, strip and roll brass.

Rod, bar and tubing of many alloys may be obtained in the extruded or drawn condition in a variety of shapes such as round, square, triangular, hexagonal, oval, fluted, etc. In the case of tubing, the inside does not always have to be the same shape as the outside. Some idea of the wide variety of shapes available may be gleaned from Fig. 1.

Copper's electrical and thermal conductivity, surpassed only slightly by silver, are practically double that of any other commercial metal. But in instances where these qualities are undesirable, they can be suppressed by suitable alloying elements. The corrosion resistance of copper is, of course, well known. Admiralty metal received its name from its use as condenser tube by the British Admiralty in its ships' condensers. Muntz metal, red brass, and arsenical copper have long been used for their resistance to mild corrosive conditions. The cupro-nickels, aluminum bronzes, and aluminum brass are modern alloys developed to meet severe corrosive conditions.

Copper and its alloys are nonmagnetic, an advantage in many electrical and electronic fields. Further, being nonsparking, they are naturally preferred where sparking would be dangerous, such as machine ap-

Table 1—Tempers and Formability of Brass Sheet, Strip and Roll

Temper Designation	Formability
Annealed (soft) Metal*	
Extra deep-drawing anneal (over 0.050-mm average diameter grains)	Special cases of deep drawing and spinning. Rough surface on drawn parts not suitable for polishing
Deep-drawing anneal (0.040-0.050-mm average diameter grains)	Common soft temper for deep drawing and spinning, Surface on drawn parts suitable for most polishing requirements
Light anneal (0.015-0.040-mm average diameter grains)	Special soft temper used for moderate drawing and cup- ping. Drawn part surfaces suitable for polishing
Hard (cold-rolled) Metal**	
%-hard	Special hard temper suitable for shallow forming
1/6-hard	Common hard temper suitable for sharp 90-degree bends. Slight radius required for lead- ed brasses
%-hard, Full-hard, Extra hard, Spring, and Extra spring tempers	These and foregoing hard tem- pers have good blanking, shearing and machining char- acteristics, Magnitude of bend radii increases with hardness

Recrystallized grains, produced by annealing hard metal at temperatures from 600 to 1200 F.
 Distorted and broken-up grains, produced by cold rolling soft metal to finish thickness.

plications in flour mills, powder plants and installations handling inflammable liquids or vapors.

COPPERS: Characteristics and properties of some of the more popular coppers are listed in Table 2.

Electrolytic tough-pitch copper, oxygen-free, highconductivity (OFHC) copper and silver-bearing copper, because of their high electrical conductivity, are used as electrical conductors, bus bars, commutator segments, electric wires and cables, and in electronic tubes and equipment. Silver-bearing copper is preferred in instances where temperatures of 500 to 700 F occur, since the silver raises the annealing temperatures, thereby retarding softening. Silver-bearing copper is recommended for commutator segments or heat transfer units where soldering is employed or high temperatures are used in assembly, in electrical contacts or circuit breakers where momentary high temperatures exist, or in electrical or thermal apparatus employed at relatively high temperatures, such as spark plug gaskets, etc. When assembly of

an article requires welding or brazing, deoxidized copper is recommended since it is not subject to embrittlement by reducing gases at high temperatures.

The auto radiator shown in Fig. 2 is an example of the use of silver-bearing copper. This application requires a material that can be easily formed, has high thermal conductivity, is easily soldered with no loss in strength due to annealing at the soldering temperature, and has good corrosion resistance.

Free-cutting or tellurium copper has excellent machining properties, high electrical and thermal conductivity, and is suitable for swaging or forging. Some of the main uses for free-cutting copper are cutting torch tips and copper studs and bolts. Fig. 3 shows a few parts made from tellurium copper for an electrical switch. This application required high conductivity, corrosion resistance, ease in machining, and moderate strength. Other representative applications of coppers are listed in TABLE 2.

In the correct tempers, coppers are suitable for deep

Table 2—Characteristics, Uses and Properties of Coppers

Characteristics, Uses and Properties	Electroly Tough P		Deoxidiz	ed	Oxygen- High Con ductivity	n-	Silver-be	aring	Arsenica Phospho		Free-Cut Copper	ting
Typical Uses	Forgings ing rolls cal commute commute kettles, etc.	ators,	Water a frigerati- equipment heat exc tubes, w sheet and construc-	on nt tubes, hanger relded d plate	Special and star parts; for ing to a electrical ment at temperat reducing	mped or seal- class; l equip- chigh tures in	Electrics mutators motive tors; wh strength quired a erately temperat	s, auto- radia- iere is re- it mod- high	er and	condens- heat ex- applica-	Screw m parts, e equipmenting torcinterior vacuum	lectrical nt, weld h tips, parts fo
Characteristics	High elections of the conductive conductive cellent was ability	vity; ermal vity; ex-	and ben qualities electroly per; pre for copp	setter forming and bending ualities than lectrolytic cop- er; preferred or copper- mithing and redding		t for awing; glass- seals; ctrical vity	High electronductives statement from 50 700 F	vity; oftening cratures	Low election conductive special conductive signification conductive significant conductive	vity; corro- stance	High electronductive conductive similar gen-free, conductive per but cutting	vity; rmal vity; to oxy- high- vity cop
Working Properties Cold-working Hot-working Machining Welding* Soldering Polishing	Excellent Excellent Fair Deoxidiz per pr Excellent Excellent	ed cop- referred	Poor Gas, car metal- Excellen	Excellent Excellent Poor Gas, carbon-arc, metal-arc Excellent Excellent		t t arc, arc t	Excellent Excellent Fair Deoxidized cop- per preferred Excellent Excellent		Excellent Excellent Poor Gas, metal-arc, carbon-arc Excellent Excellent		Good Good Excellent Not recom- mended Good Excellent	
Weight (lb per cu in.)	0.322		0.323		0.323		0.322	0.322			0.323	
Modulus of Elasticity(psi)	17,000,000		17,000,000		17,000,00	00	17,000,000		17,000,00	00	17,000,00	00
Coef. of Thermal Expansion (average, per deg F from 68 to 570 F)	0.0000098	8	0.0000098		0.000098		0.000098		0.000096		0.0000098	
Electrical Conductivity (% IACS at 68 F)	101 (ann	ealed)	85 (annealed)		100 min.		100 min.		45		90 min.	
Thermal Conductivity (Btu/sq ft/ft/hr/deg F at 68 F)	226		196		227		227		102		205	
Tensile Strength (thousands psi) Sheet Rod Tube	Hard 50 48 55	Soft 32 32 32 32	Hard 55  55	Soft 32  32	Hard 50	8oft 32	Hard 52	33 	Hard  60	Soft  37	Hard 53	Soft
Elongation in 2 in. (%) Sheet Rod Tube	6 16 8	45 55 45	5 8	45  45	5	40	5	40	::	42	. <del>.</del>	40
Yield Strength (0.5% ex- tension, thousands psi) Sheet Rod Tube	45 44 50	10 10 10	42 50	10 10	48	8	48	7	48		49	Ť
Rockwell Hardness Sheet	50B 47B 60B	40F 40F 40F	50B 60B	40F	50B	40F	55B	40F	95 <b>F</b>	28F	45B	40F

<sup>·</sup> Conductivity of coppers makes resistance welding (spot and seam) impractical. Coppers may be brazed, however, by a patented method.

drawing, spinning, forming, cold heading, stamping, coining, embossing, bulging and blanking.

BRASSES: These well-known alloys of copper and zinc are used in practically every industry and are the best known of all the copper alloys. By selection of the proper alloy, the designer secures higher tensile and yield strength, greater elongation or hardness, better corrosion resistance to certain environments, or suitable color.

Because of the high ductility and malleability of the brasses, with their low work-hardening rate (which reduces or eliminates the necessity of intermediate anneals), they are especially suitable and economical in cases involving a great amount of deformation, as in deep drawing. TABLES 3, 4 and 5 show some of the properties of the most common brasses along with a number of representative applications. There is a brass for practically any spinning, forming, bending, stamping, drawing, plating or welding application.

Since cartridge brass has the best combination of ductility and strength of all the brasses it was chosen for those applications shown in Fig. 4, where deep draws and high strength are required. By using this material in the annealed temper with a grain size of 0.040 to 0.050-mm, deep draws were possible without sacrificing a smooth surface suitable for polishing or plating. Intermediate anneals were necessary, however, between some of the draws of the deep cylindrical articles shown in the left of Fig. 4. By closely controlling these anneals, grain growth was not experienced and the smooth surface was retained. In applications where a smooth surface is not as critical, material may be used having a larger grain size en-

Table 3—Characteristics, Uses and Properties of Brasses

Characteristics, Uses and Properties	Gilding	, 98%	Comme Bronze,		Red Bra (Rich Bras		(Red	Brass, 80% Brass,	Cartrid	ge Brass,	Yellow	Brass		Metal Metal)
Typical Uses		o be gold or highly	Forging screws, therstrip stamped ware	wea- pping,	ators,	bile radi- tube and r oil and fields and	Thermo lows, d drawn			ge cases amunition ents	duced b	rts pro- by prac- all proc- bins, riv- dets, etc.	Condens valve s brazing	tems,
Characteristics	ductility	has	Excellent cold- working prop- erties, very ductile		and due than co- ceilent or resistant ter at h perature	Higher strength and ductility than copper, excellent corrosion resistance; better at high temperatures than higher zinc al-			Best co tion of and streamy bra cellent working erties	ductility ength of uss; ex- cold-	sion res	proper- nbined od corro- sistance	High st combine low due	d with
Working Properties Cold-working Hot-working Machining Welding Soldering Polishing			xcellent Excellent coor Good oor Poor as, carbon-are metal-are xcellent Excellent			Excellen Good Poor • Excellen Excellen	t	Excellen Good Fair Excellen	t	Excellen Poor Fair • Excellen	t	Fair Excellen Good * Excellen	ıt	
Weight (lb per cu in.)	0.320	0.320 0.318		0.316		0.313		0.308		0.308		0.303		
Modulus of Elas- ticity (psi)	17,000,000		17,000,000		17,000,000		16,000,000		16,000,000		15,000,000		15,000,000	
Coef. of Thermal Expansion (aver- age, per deg F from 68 to 570 F)	0.0000100		0.0000102		0.0000104		0.0000106		0.0000111		0.0000113		0.0000116	
Blectrical Conduc- tivity (% IACS at 68 F)	56		44		37		32		28		27		28	
Thermal Conduc- tivity (Btu/sq ft/ ft/hr/deg F at 58 F)	135		109		92		81		70		67		71	
Tensile Strength (thousands psi) Sheet Rod	Hard 56	Soft 34	Hard 61 60	37 40 38	70 57 70	Soft 40 40 40	Hard 74 65 89	Soft 44 43 43	Hard 76 70 78	Soft 47 48 47	Hard 74 60	8oft 47 48	Hard 80 75 74	Soft 54 54 56
Elongation in 2 in.(%) Sheet Rod	5	45	5 20	45 50 50	5 23 8	47 55 55	7 20 5	50 60 45	8 30 8	62 65 65	8 25	62 65	10 20 10	45 50 50
field Strength 0.5% extension, housands psi) Sheet Rod Tube	50	10	54 55	10 10 12	57 52 58	12 10 12	59 55 55	14 12 12	63 52 64	15 16 15	60 45	15 16	60 55 55	21 21 23
Rockwell Hardness Sheet Rod Tube	64B	46F	70B 60B	53F 55F 57F	77B 75B 77B	59F 55F 60F	82B 75B 85B	61F 65F 60F	82B 80B 82B	64F 65F 64F	80B 70B	64F 65F	85B 80B 80B	80F 80F 82F

<sup>·</sup> Gas, carbon-arc, metal-arc, spot and seam welding for thin gages.

abling deeper draws to be made between anneals, or possibly without annealing,

The leaded brasses listed in Table 4 are the free-machining varieties of copper alloys. Lead is not dissolved in the brass but is finely distributed throughout the metal in microscopic particles. These lead particles reduce friction while machining, by causing chips to break off short; consequently, they are in only momentary contact with the cutting edge of the tool. This action greatly increases the useful life of the tool.

Free-cutting brass is the favorite of screw machine operators and is ideal for any machining requirements in rod form. This metal, in spite of its increased machinability, is strong. It can be cut, roll threaded, drilled and tapped, milled, broached, and sawed, with no appreciable burrs.

High-leaded brass, or engraver's brass, is used for flat products that require routing, milling, turning or blanking. It is used extensively by printers and engravers for plates because of its clean machining characteristics, leaving no burrs or rough areas that would prove to be detrimental in printing. When blanking this material, closer die clearances should be employed than for any of the nonleaded alloys.

These smaller clearances enable closer tolerances to be maintained on the part being blanked and often eliminate the necessity of deburring edges or reaming holes or notches.

Low-leaded brass tube is recommended for tubular designs necessitating an appreciable amount of machining, such as bushings, washers, and collars.

Free-cutting brass rod and leaded brass tube produce savings in making possible adequate quality at low-cost, high-production rates, longer tool life, and less machine maintenance. Leaded brass tube can be obtained in a multitude of shapes, with hexagon, square, fluted or irregular-shaped outside and inside surfaces, or combinations of these. Fig. 5 shows some screw machine parts which were made from both tube and rod.

The clock shown in Fig. 6 employs leaded brass for flat parts that are machined or blanked, such as gears, plates, backs and bases; free-cutting brass for machined items made from rod, as bearings, screws, bolts, hubs, collets, etc.; and cartridge brass for drawn or formed parts, such as cases, bezels, covers, hands, dials and molding. Phosphor bronze is used for many of the springs, washers and bushings.

Tin brasses have been best known for their corro-

Table 4—Characteristics, Uses and Properties of Leaded Brasses

Characteristics, Uses and Properties	Low-Lead Brass (Tu		High-Lead (Engraver		Free-cuttin Brass	ng	Forging B	rass -	Architectus Bronze	ral		
Typical Uses	Screw maparts, electronic parts, pig- liners	trical fuse	Instrumen lock parts nameplate parts	, gears,	Screw maparts	chine	Hot forging plumbing,		Industrial shapes: hi bodies, au parts	nges, loc		
Characteristics	Free mack combined erate cold ability	with mod-	Free mack good blan	nining and king	Excellent ability, go chanical a rosion resi properties	ood me-	Extremely hot; good resistance, mechanica ties	corrosion	Excellent and free properties			
Working Properties Cold-working Hot-working Machining Welding Soldering Polishing	Fair Poor Good Nonleaded preferre Excellent Excellent		Poor Poor Excellent Nonleaded preferre Excellent Excellent		Poor Good Excellent Nonleaded preferre Good Excellent		Fair Excellent Good Nonleaded preferre Good Excellent		Very poor Excellent Good Poor Excellent Excellent			
Weight (lb per cu in.)	6.307		0.306		0.307		0.305		0.305			
Modulus of Elasticity (psi)	15,000,000		15,000,000		14,000,000		15,000,000		14,000,000			
Coef. of Thermal Expansion (average, per deg F from 68 to 570 F)	0.0000112		0.0000113		0.0000114		0.0000115		0.0000116			
Electrical Conductivity (% IACS at 68 F)	26		26		26		27		28			
Thermal Conductivity (Btu/sq ft/ft/hr/deg F at 68 F)	67		67		67		69		71			
Tensile Strength (thousands psi) Sheet Rod Tube	Hard	Soft	Hard 74	8oft 49	Hard 58	Soft 49	Hard	Soft 52	Hard	Soft 60		
Elongation in 2 in. (%) Sheet Rod Tube	·· ;	60	7	52	25	53	0 0	45	• •	30		
Yield Strength (0.5% ex- tension, thousands psi) Sheet Rod	ėo	15	60	17	45	18	• •	20	::	20		
Rockwell Hardness Sheet	80B	 64F	80B	68F	78B	682		78F	**	65B		

sion resistance in condensers and heat exchangers. In recent years, however, has come realization that the alloying of small amounts of tin in various strip alloys enhances spring properties.

Naval brass and Roman bronze have long been popular for pump shafts and piston rods. Screw machine parts such as marine hardware requiring the corrosion resistance of naval brass are better made with a leaded naval brass if a slight sacrifice in physical properties can be tolerated. However, the unleaded variety machines well.

Manganese bronze has the highest mechanical properties of all the brasses, together with good abrasion and corrosion resistance. Typical uses are in valve stems, slotted or perforated screens, bolts, valve seats, dies, clutch disks and springs.

All brasses containing about 60 per cent copper have excellent forging and hot working properties. Consideration should be given to fabrication by forging if fairly heavy walls can be tolerated. One forging operation may produce a part that would require several cold draws. The part will be stronger than a drawn

article, both because of the heavier sections and because these hot working alloys are fundamentally high strength mixtures. Forging is sometimes referred to as "plastic machining" in recognition of the complicated surfaces that may be generated in the one operation. A forging has, of course, the additional features of smooth surface, freedom from porosity, etc., which mean low finishing costs comparable to die castings. When designing brass parts the designer should consider the overall cost of manufacture by forging, cold forming, casting, machining from bar stock, and possibly simpler machining from extruded shapes. Typical finished and semifinished parts where forging proved to be the most economical method of manufacture are shown in the photograph, Fig. 7

BRONZES: Properties and characteristics of the most common bronzes are listed in Table 6. Tin bronzes, or so-called phosphor bronzes (because they are deoxidized by phosphorus), have superior fatigue and abrasion resistance properties, and produce excellent springs having long life and tarnish resist-

Table 5—Characteristics, Uses and Properties of Tin Brasses

Characteristics, Uses and Properties	Cháin B	ronze	Admiral	lty	Roman	Bronze	Naval B	rass	Leaded Naval B	rass	Mangan Bronze	
Typical Uses	Chains		plates a marine	er and changer nd tubes, uses, au- e aerials	Propelle pump a piston r rine use	hafts, ods, ma-	and ster	changers am con-	Screw n parts, f bolts, n hardwar	orgings, narine	Forging denser valve s coal scr	plates tems,
Characteristics	Combine strength ductility	and	Excellent corro- sion resistance, strength and ductility		Fine, un grain s high re to fatign salt was rosion	tructure; sistance ue and	water c	king op-	Cutting but with creased	strength osion re-	High st combine excellent resistant	d wit
Working Properties Cold-working Hot-working Machining Welding Soldering Polishing	Good Fair Poor Excellen Excellen		Good Poor Fair Gas, ca Good Good	Poor Fair Gas, carbon-are		Fair Excellent Good  Excellent Excellent Excellent Excellent Excellent Excellent			Poor Good Excellen Nonlead prefer Good Excellen	ed brass red	Poor Excellen Good • Excellen	ıt
Weight (Ib per cu in.)	0.317		0.308		0.304		0.304		0.305		0.302	
Modulus of Elasticity (psi)	15,000,00	00	16,000,0	00	15,000,0	00	15,000,0	00	15,000,0	00	15,000,0	00
Coef. of Thermal Expan- sion (average, per deg F from 68 to 570 F)	0.000010	4	0.000011	2	0.0000119		0.0000118		0.0000118		0.000011	8
Electrical Conductivity (% IACS at 68 F)	30		25		26		26		26	Ş	24	
Thermal Conductivity (Btu/sq ft/ft/hr/deg F at 68 F)	81		64		67		. 67		67		61	
Tensile Strength	Hard	Soft	Hard	Soft	Hard	Soft	Hard	Soft	Hard	Soft	Hard	Sof
(thousands psi) Sheet Rod Tube	67	45	85 100	50	82	60	90 75 88	58 57	90 75	58 57	84	65
Elongation in 2 in. (%) Sheet	5	45	5	55 65	20	45	5 20 18	40 47	5 15	35 40	19	33
Yield Strength (0.5% ex- tension, thousands psi) Sheet	50	12	70 80	18	55	22	70 53 66	20 25	70 53	20 25	60	30
Rockwell Hardness Sheet	80B	60F	90B 95B	25B 75F	80B	50B	90B 82B 95B	45B 55B	90B 82B	45B 55B	90B	651

<sup>·</sup> Gas, carbon-are and metal-arc. For thin gages, spot and seam welding.

ance. They are employed in innumerable spring applications, including diaphragms, bellows, lock washers, latches, relay parts, flexible hose, etc. They are essential in many machines, instruments, etc., in the paper mill, oil well, textile, leather, laundry, pump, printing, refrigeration, electrical, marine and automotive industries. Because of their wear properties, these alloys are also used as wear plates, thrust washers, and clutch disks. They have high tensile strength, excellent corrosion resistance, fair electrical conductivity, and easy workability.

Phosphor bronze was picked for the application shown in Fig. 8 because of its high strength, fatigue resistance, corrosion resistance, ease of welding, and easy workability. It assures extreme flexibility, long life, resistance to prolonged vibration, and resistance to contraction and expansion stresses caused by temperature changes.

#### Aluminum Bronzes High in Many Properties

Aluminum bronzes, because of their excellent corrosion resistance, are used for condenser tubes, for marine equipment such as pump housings, pump rods and shafts, valve fittings, valve stems, nuts and bolts. propellers, and marine trim. Wheels, spindles and other fittings of sluice gates and other harbor equipment are also made of these alloys. Chemical and related industries use the aluminum bronze alloys for pickling crates, chains, and hooks for use with sulphuric, hydrochloric and other acids. Pump bodies, impeller blades, and other working parts in contact with acid or acid fumes, such as fans, are made of these alloys. Aluminum bronzes have proven their worth in contact with hydrofluoric acid, being used in washing machines for bottles that have been etched in this acid. They are used extensively for beater bars and blades in wood pulp machines, where they may be subjected to sulphite and other oxidizing agents in severe abrasive conditions.

Because aluminum bronzes have good heat resisting qualities, they are used for valve seats and guides, spark plugs, and even cylinder heads in some types of internal combustion engines. They do not tend to form oxides which flake off.

Excellent resistance to wear and high mechanical strength make aluminum bronzes particularly suitable for heavy-duty bearings, gears, worm nuts and wheels, selector forks on automotive transmissions and machine tools, and roller bearing cages. They may be used for drill-jig and boring-bar guide bushings, turntable roller bushings in excavating machinery and cranes, nonsparking tools, aligning plates for machines, and screw-down nuts on rolling mills.

Aluminum bronze alloys that are susceptible to hardening by heat treatment are also available, principally as hot forging alloys.

SILICON BRONZES: These alloys have mechanical properties comparable to mild steel plus corrosion resistance comparable to that of copper. In addition, they possess exceptional toughness, high resistance to shock or impact loading, excellent fatigue strength, and are nonmagnetic.

High-silicon bronze is used in making unfired pres-

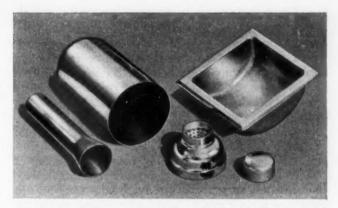


Fig. 4—Above—Where ductility and strength are required, as in the production of these deep-drawn parts, cartridge brass is indicated

Fig. 5—Below—Use of free-cutting brass rod and tube makes possible minimum-cost production of a wide variety of screw machine parts such as these

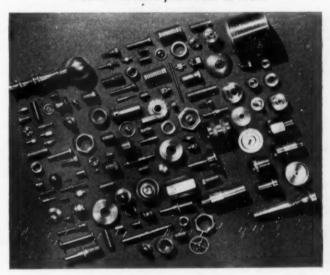


Fig. 6—Below—Many different copper-base alloys are used for parts of this clock, including gears, plates, bearings, screws, case, hands, dial, and molding



sure vessels with steam pressures up to 125 psi, vats, fire extinguishers, centrifugal drying and laundry baskets, hydraulic pressure systems, and in water works, sewage disposal plants, mining operations and general engineering projects where the savings caused by reductions in maintenance and replacement costs are substantial. Silicon bronzes are excellent forging metals.

Low-silicon bronze is usually specified for cold working. Bolts, nuts, screws, lag screws, rivets, cotter pins, and similar fastening devices are made of silicon bronze where strong, fatigue resisting, corrosion resisting properties are required. Cold-headed bolts and screws can be made with tensile strengths up to 110,000 psi, depending on size and shape. Elongation in 2 inches varies from 8 to 30 per cent. Endurance limit (100,000,000 cycles) is between 25,

000 and 30,000 psi. Hot-headed bolts can be made with a minimum strength of 65,000 psi. Bolts may be bent from 90 to 180 degrees or given four to ten twists in 10 inches, depending on temper.

Silicon bronze's high strength, good wear and corrosion resistance, cold working and forging properties all make it a favorite in the manufacture of valves. Since the bodies, stems, disks, seats, bonnets and nuts can all be made of the same material, the danger of corrosion by electrolytic action is avoided. Silicon bronze is also used extensively for the manufacture of hot water tanks. Used in the cold-rolled condition, it lends high strength to the vessel and permits light gages to be used. It is readily welded by the carbon-arc or inert-gas, shielded-arc processes. Its excellent corrosion resistance gives reasonable life and trouble-free service in waters too corrosive for steel.

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Tens (thou Eh Ro Tu

Elon in. (9 She Ro Tu

Yield (0.59) thous She Ro

Rock She Roc Tul

M

Table 6—Characteristics, Uses and Properties of Bronzes

	Aluminum	Bronzes		Tin Bronzes		Silicon B	- OmeCB	
Characteristics, Uses and Properties	Aluminum Bronze, 5%	Aluminum- Silicon Bronze	Phosphor Bronze 5% (A)	Phosphor Bronze 8% (C)	Bearing Bronze	High-Silicon Bronze (A)	Low-Silicon Bronze (B)	
Typical Uses	Condenser tubes, high-strength forgings, tie bolts		Diaphragms, bellows, wash- ers, cotter pins, clutch disks, springs, screw machine parts	Springs, perfor- ated sheets, bel- lows, cotter post, fuse clips, bushings and lock washers	Bushing material for light loads, weatherstrip ap- plications, fuse clips, lamp con- nections	Tanks, marine construction, weatherstrips, forgings, con- duits, hydraulic pressure lines	Cold-headed bolts, nuts, screws, hydrat lic pressure lit cotter pins	
Characteristics	High physical properties, high resistance to acids; most re- sistant of bronzes to H <sub>2</sub> S	High tensile strength, excel- lent corrosion resistance, read- ily hot-forged, rolled and ex- truded, free ma- chining	High tensile strength, high resistance to corrosion and fatigue, low fric- tion coefficient, high immunity to season cracking	Corrosion and fatigue resist- ance high, fric- tion coefficient low, high tensile strength	High physical properties, re- sistant to at- mospheric corro- sion and tarnish, low friction co- efficient	Corrosion resist- ance of copper, mechanical prop- erties of mild steel	Tensile propeties comparabto cartride brass, corrosi resistance similar to that of copper; weldin properties goo nonmagnetic	
Working Properties Cold-working Hot-working Machining	d-working Good Poor working Good Excellent		Excellent Poor	Excellent Poor	Excellent Excellent if lead-free Fair	Good Excellent	Excellent Excellent	
Welding Soldering Polishing	Gas, carbon-arc, metal-arc Good Good	Gas, carbon-arc, metal-arc Fair Excellent	Gas, carbon-arc, metal-arc* Excellent Excellent	Gas, carbon-arc, metal-arc* Excellent Excellent	Gas, carbon arc, metal-arc Excellent Excellent	Gas, carbon arc, metal-arc* Excellent Good	Gas, carbon a metal-arc* Excellent Fair	
Weight (1b per cu in.)	0.295	0.278	0.320	0.318	0.315	0.308	0.316	
fodulus of Elas- icity (psi)	17,000,00m	14,000,000	16,000,000	16,000,000	15,000,000	17,000,000	17,000,000	
coef. of Thermal expansion (average, er deg F from 68 o 570 F)	0.0000099	0.0000092	0.0000099	0.0000101	0.0000102	0.0000100	0.0000099	
Electrical Conduc- ivity (% IACS at 8 F)	18	7	18	13	39	7	12	
Thermal Conductiv- ty (Btu/sq ft/ft/ tr/deg F at 68 F)	48	22	47	36	100	21	33	
ensile Strength	Hard Soft	Hard Soft	Hard Soft	Hard Soft	Hard Soft	Hard Soft	Hard Soft	
thousands psi) Sheet	85 65 70 50	95 85	81 47 70	93 55	65 45	94 60 92 58	65 45 70 45 65 45	
longation in 2 in. %) Sheet Rod	64 20 60 25 60	25 35	10 64 25	10 70	5 42	8 60 22 60	8 45 15 60 20 55	
eld Strength .5% extension, ousands psi) Sheet	55 20	53 43	75 19 58	2	57 10	58 25 55 22	50 15 55 15 40 20	
ockwell Hardness Sheet	72F 85B 40B 80B 55F	82B 75B	87B 73F 78B	93B 75F	76B 55F	93B 85F 90B 60B	77B 601 80B 601 75B 681	

<sup>°</sup> For thin gages, spot and seam welding.

COPPER-NICKEL ALLOYS: Alloys of copper and nickel are divided into two basic groups: cupronickels and nickel silvers (copper-nickel-zinc alloys). Characteristics, uses and properties of both groups are covered in Table 7.

Cupro-nickels have both high corrosion and erosion resisting properties, being used mainly in installations subject to impingement types of attack. They are the most resistant of the copper alloys to stress corrosion and corrosion fatigue types of failure and exhibit superior results in contact with corrosive media where vibrations or stresses occur. They are used as condenser tubes and plates, bolts, nuts and screws, as ammunition components, process equipment, automotive parts, meters, and refrigerator valves.

Attractive color is an outstanding quality of nickel

silvers. Varying amounts of nickel give a range of tinges including blue-white, greenish, pink and yellow-white. The nickel improves the mechanical properties of copper and greatly increases corrosion and tarnish resistance. Lead may be added to improve the machining, blanking and shearing properties. Nickel silvers are used in quality fishing reels, rivets, screws, truss wire, zippers, optical goods, etching stock, nameplates and radio dials.

Numerous spring applications employ nickel silver because of its high endurance strength, pleasing appearance, resistance to corrosion and low electrical conductivity. These properties combined with a relatively high modulus of elasticity particularly fill the requirements for strong, exposed springs. Ease of blanking and coining combined with high strength,

#### Table 7—Characteristics, Uses and Properties of Copper-Nickel Alloys

ı											-	-			
	Characteristics, Uses and Properties	Nickel 18% (A (Deep l		Nickel S 18% (B (Spring	)	Nickel 8 15%	Silver,	Nickel 8 10%	Silver,	Nickel 8	Silver,	Nickel S Leaded	silver,	Cupro-Ni 30%	ickel,
	Typical Uses	camera various ment in process	equip-	Springs, truded a equipme process tries	hapes, nt in	Matchin plements	g com- ary trim	Stampings, em- bossings, deco- rative trim		Color, decorative trim		Products ing mac ity, lock ers, cotte fuse clip	wash- er pins,	Condense and plat tanks, ve vessels, motive p nuts, bol screws, l ator pun valves	es, ats, auto- arts, lts, refriger
	Characteristics	tarnish, malle- able and ductile. Color: silver- blue-white tarnish, high fatigue strength. Color: blue- white		propertic resistant corrosion tarnish, able and	High physical properties, high resistance to corrosion and tarnish, malle- able and ductile, Color: white		Ductile, good deep drawing properties. Color: yellow- white		good awing es. eellow-	Good manual control of the control o	Prefer d for and	High str high duc resistant rosion as sion. Col white-silv	tility, to con nd ero- lor:		
	Working Properties Cold-working Hot-working Machining Welding			Fair		Good Fair Fair		Excellen Fair Fair	ŧ	Excellen Fair Fair	t.	Poor Fair Excellen Nonleade prefer	ed red	Excellent Fair Fair Gas, me resista	tal-arc
	Soldering Polishing	Exceller Exceller		Excellen Excellen			Excellent Excellent		t	Excellen Excellen		Excellent Excellent		Excellent Good	
1	Weight (lb per cu in.)	0.316		0.314		0.314		0.313	0.313			0.314		0.323	
1	Modulus of Elas- ticity (psi)	18,000,0	00	18,000,00	18,000,000		18,000,000		17,000,000		16,000,000		17,000,000		00
	Coef. of Thermal Expansion (average, per deg F from 68 to 570 F)	0.000009	0.0000090 0.0000093		0.000083		3	0.0000083				0.0000083		0.0000090	
	Electrical Conduc- tivity (% IACS at 68 F	6		5.5		6		8		12		7		4.6	
	Thermal Conduc- tivity, (Btu/sq ft/ ft/hr/deg F at 58F)	19		17		20	20		27		îr i	23		17	
1	Tensile Strength	Hard	Soft	Hard	Soft	Hard	Soft	Hard	Boft	Hard	Soft	Hard	Soft	Hard	Soft
1	(thousands psi) Eheet	85	58	100	60	84	55	86	55	85	55	78	55	78 75	54 54
١	Rod	**		**	**	**	**		**		* *			80	60
-	Elongation in 2						- 11	-	-						
1	in.(%) Sheet	3	40	3	40	5	40	8	40	5	60	5	40	.5	35
١	Rod			**	**	**	::				**			15	45
-	Yield Strength (0.5% extension, thousands psi)							arth	75 / 1	is so	11 11	uly) il			
1	Sheet	74	25	85	27	75	20	75	20	68	20	75	18	75	16 18
	Rod	**	::			**	**		***	**				10	25
	The State of Land							1070	193	STATE OF	don!	11 - 27 / / /			TA
	Rockwell Hardness Sheet	87B	85F	91B	90F	1% 85B	40B	85B	35B	85B	35B	82B	35B	85B	40B
- 1	Rod			1					**					80B	35B
U	Tube										**			82B	SUF

<sup>\*</sup>Gas, carbon arc, metal arc. For thin gages, spot and seam welding.

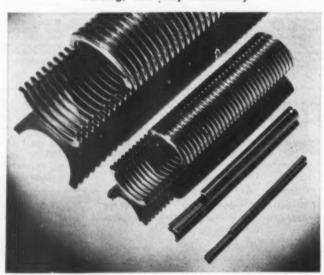
pleasing color and tarnish resistance make leaded nickel silver suitable for lock washers, cotter pins, fuse clips, etc.

Beryllium Copper: This is the outstanding heattreatable copper alloy. It responds to a relatively simple precipitation hardening treatment. A common use is for complex springs which could not be formed



Fig. 7—Above—Representative group of brass, bronze and copper forgings, showing the flexibility in design that may be employed, guaranteeing strong, smooth-finished parts

Fig. 8—Below—Phosphor bronze was selected for these flexible metal hoses because among its qualities are high strength, fatigue resistance, corrosion resistance, ease of welding, and easy workability



in the hardened state. Because this alloy has easy formability in the soft condition and a high proportional limit, high fatigue endurance, and great creep resistance in the hardened state, it can be used for springs of this type by hardening after forming. It is also used for hard, corrosion resistant nonmagnetic parts that wear well against hardened steel.

About 20 years ago a compilation was made which showed that there were on the market over 900 different wrought alloys having a copper base. Most of these were closely related to each other metallurgically. The modern trend is to simplify the lists of mixtures, standardizing on a relatively few alloys having distinctly different properties. Engineering advice from the brass supplier operating on this principle usually enables the designer to secure the properties that he wants in these readily available

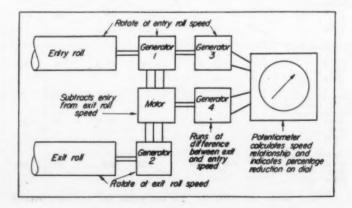
standard mixtures and tempers. When a new alloy is developed nowadays it must fill a real economic need in order to justify its existence. Few, indeed, are the requirements that are not satisfied by a standard alloy manufactured by modern careful mills with scientific quality control.

#### New Strip-Mill Extensometer Developed

U NIQUE type of continuously indicating and recording extensometer measures extension of strip steel during rolling in temper-pass mills. It was common practice, prior to installation of this instrument, to measure strip extension by a hand operated gage, and such measurements could not be obtained satisfactorily at mill operating speeds in excess of approximately 200 feet per minute. Installation of the equipment, permits extension measurements at operating speeds up to 2000 feet per minute.

The extensometer is designed to indicate and record the percentage of extension being effected on the temper-pass mill by measuring the entry and delivery speeds of the strip, and comparing the differential between the two speeds with the entering strip speed. Entry-delivery strip speed differential is obtained with a system consisting of two synchronous transmitters, one driven by the entry roll and the other driven from the delivery deflector roll. The synchronous transmitters are electrically connected to a synchronous differential receiver, the receiver driving a tachometer generator that generates a voltage proportional to the true differential speed. A second tachometer generator is driven by the entry deflector roll and generates a voltage proportional to the strip entry speed. These two voltages are applied to a self-balancing potentiometer which indicates the ratio of the two voltages. Since this ratio is proportional to the strip extension, the potentiometer is calibrated accordingly.

The illustration shows a schematic arrangement of the apparatus required for a typical temper-pass mill extensometer installation. The equipment, developed by the United States Steel Corp., is designed to operate with an accuracy of approximately 0.04 per cent over a range of 8 to 100 per cent of normal strip operating speed, while measuring extensions varying from 0.1 per cent to 8 per cent.





SPECIAL automatic and semiautomatic machines designed around basic "package units" can cut production costs drastically and promote increased uniformity in the finished pieces. The machine shown in Fig. 1 is an excellent illustration of an arrangement of this type—a semiautomatic unit that performs four operations on a bicycle pedal crank, Fig. 2. This machine employs three production drilling units and two tapping units which are operated by air pressure with a hydraulic check for feed control.

Built by the Black Drill Co. with a patented traversing rotor, these unique package units eliminate the customary splined shaft and apply torque directly to the tool mounted on the solid motor shaft, so that lost motion and play is reduced practically to zero,

Fig. 3. The motor rotor actually shifts in and out of the magnetic field, provision being made in the motor windings to compensate for loss of torque and to dissipate the heat. The units operate in any position or at any angle and the design is flexible so that they are easily modified to incorporate extended shafts and extralong strokes.

A special ¾-hp unit with a 6-inch stroke, operating at 1150 rpm, performs a ¾-inch diameter hollow milling operation on the driving lug for the sprocket on the pedal crank. This unit required a long stroke in order to clear the frame of the machine—4 inches of nonrotating travel and 2 inches of working travel. Thus, with the standard-length stator the rotor leaves the magnetic field completely on the return stroke. A built-in limit switch automatically turns the motor

on and off as the rotor enters and leaves the magnetic field. This is entirely feasible as the rotor attains full speed within  $1\frac{1}{2}$  turns.

Two standard \( \frac{4}{4}\)-hp units operate at 840 rpm for a combination operation consisting of 7/16-inch tap drilling and \( \frac{4}{4}\)-inch diameter spot facing of the bicycle pedal holes. Spot facing is held to close limits through the depth adjustment control on the unit which is capable of repeating within 0.001-inch.

The last operation consists of tapping the two pedal holes  $\frac{1}{2}$ -20 National threads, one right-hand and one left-hand, with two opposed tapping heads. These are standard tapping units, 540 rpm, built with the same traversing type motor rotor design. The tapper is also operated by air pressure through a double-acting air cylinder controlled by a built-in four-way air valve. Adjustable needle valves control the flow of air so that the tap follows its own lead without chamfering the first threads and does

not strip the threads on the return stroke. A class 3 thread can be regularly produced.

Automatic reversal is obtained through a secondary air cylinder, mounted on top of and operating from the same air supply as the main cylinder, Fig. 4. A limit switch that operates through a magnetic reversing starter reverses the motor when the tap has reached the proper depth and the main air cylinder starts the return stroke. Depth control is held within 0.001-inch so that there is no danger of tap breakage even when tapping blind holes. These tapping units are designed to work in any position or at any angle.

All five units on this machine are controlled electrically through solenoids and limit switches. Interlocking will not permit any unit to advance until the machine has indexed to proper position and will not allow the machine to index until the units are completely retracted to initial position.

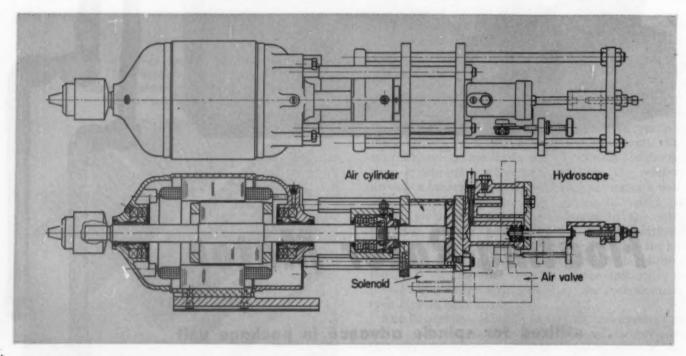
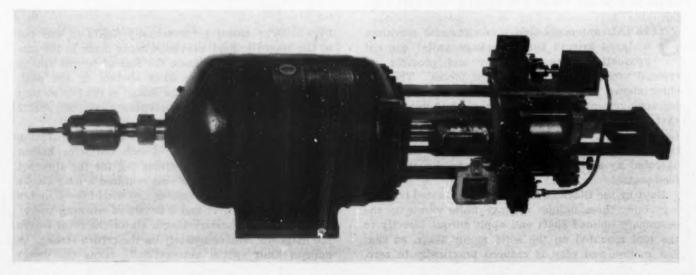


Fig. 3—Above—Cross section of floating rotor drilling unit showing pneumatic actuator and hydraulic feed control

Fig. 4—Below—Automatic tapping head with secondary air control valve and limit switch visible on main cylinder



## Relay Circuit Analysis

electrical or hydraulic—is open or closed has previously required a type of mathematics with which few engineers are familiar. To avoid introducing this higher mathematics, a simple type of mathematics, called odd-even algebra, can be used. This algebra differs from conventional algebra in two ways: (1) only whole numbers are used and (2) every even number is considered to be the same as zero while every odd number is considered to be the same as the number 1. This second rule makes several interesting changes in the appearance of the laws, e.g., 1 + 1 = 0, but they are easily understood.

BASIC VOCABULARY: In translating from circuits to formulas it is necessary to relate the two possible positions of a switch to the two possible representative numbers and also to give the elementary formulas for series connection and parallel connection. These facts are matters of definition, and are as follows:

- 1. A closed switch is represented by an odd number
- 2. An open switch is represented by an even number
- If X represents one switch and Y represents another, then the system consisting of the two switches in series is represented by XY
- 4. If X represents one switch and Y represents another, then the system consisting of the two switches in parallel is represented by X + Y + XY

The foregoing basic facts are illustrated in Fig. 1. For example, if two closed switches are in parallel, the first switch may be represented by 3 and the second by 5. The number for the parallel connection will be 3+5+15=23. As 23 is an odd number, the parallel circuit is itself closed. In practice, it is convenient to let 1 represent all odd numbers and 0 represent all even numbers, but this is a convenience rather than a necessity.

LAWS OF ODD-EVEN ALGEBRA: The multiplication table for odd-even algebra consists of only four products which agree with the customary algebraic laws:

- $0 \times 1 = 0$ ; an even number times an odd number is an even number
- $1 \times 0 = 0$ ; an odd number times an even number is an even number
- 0 × 0 = 0; an even number times an even number is an even number
- 1 × 1 = 1; an odd number times an odd number is an odd number

The addition table also has four elements. The first three are identical with ordinary addition. The fourth law of addition appears different because 2,

. . . by "odd-even" algebra

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A UNIQUE APPROACH to circuit design is presented in this article. Based on a new but easily understood system, the principles outlined have considerable practical value in simplifying circuits as well as in determining their condition for any combination of relay positions

Fig. 1—Closed switch is represented by odd number (1) and open switch by even number (0) as shown at left. Series and parallel circuits and their representation are shown at right

Fig. 2—Three-way switch circuit, such as is used for two-station light control, has two complementary switches. When X is open X' is closed, and vice versa. Complete circuit is represented by X + Y + 1 from which it is seen that a change in either X or Y changes the entire circuit

Fig. 3—Simple bridge circuit with relays A, B, C, and D. Formula for circuit is given in Equation 10

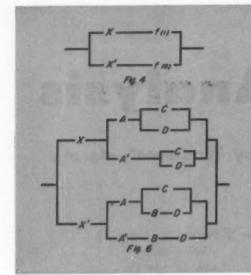
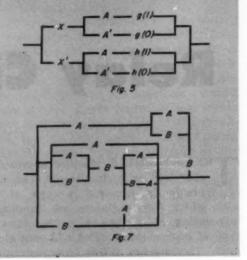


Fig. 4 — Circuit represented by Theorem 1 in the article

Fig. 5—Circuit for the expansion about two switches

Fig. 6—Successive expansion of circuit such as shown in Fig. 5

Fig. 7—Circuit made up of several positions of switches A and B, which is equivalent to A in parallel with B



being an even number in conventional algebra, becomes identified as 0 in odd-even algebra:

0 + 1 = 1; an odd number added to an even number is an odd number

1 + 0 = 1; an even number added to an odd number is an odd number

0 + 0 = 0; an even number added to an even number is an even number

1 + 1 = 0; an odd number added to an odd number is an even number

From the last two laws of multiplication, it will be observed that any power of a quantity is identical with the quantity:

$$X^n = X \dots (1)$$

where n is a positive integer.

From the last two laws of addition, it should be noted that any quantity added to itself equals zero and thus in any expression two like terms can be cancelled:

$$X + X = 0 \dots (2)$$

Because of Equations 1 and 2, exponents or coefficients are not needed in odd-even algebra.

It will be observed that odd-even algebra obeys the laws of ordinary algebra if we withhold the identification of even numbers with zero and odd numbers with unity until the very end of the calculations, which is permissible. The only necessary change in thinking is the concept of identifying a whole class of numbers with a single number.

COMPLEMENTARY SWITCHES: Two switches are complementary if one is always in the opposite position from the other. Designating the complement of X by X', X is open when X' is closed and X is closed when X' is open. The formula for X' is:

$$X' = X + 1 \dots (3)$$

The three-way switch circuit is in effect two complementary switches, the circuit employing two three-way switches being shown in Fig. 2. The formula for this circuit is derived as follows: The formula for the upper branch is XY. The formula for the lower

branch is (X + 1) (Y + 1) = XY + X + Y + 1. Combining these two formulas by use of definition 4 under Basic Vocabulary, the formula for the circuit is:

$$XY + (XY + X + Y + 1) + XY (XY + X + Y + 1)$$

Removing parentheses:

$$XY + XY + X + Y + 1 + X^2Y^2 + X^2Y + XY^2 + XY$$

Applying Equation 1,

$$XY + XY + X + Y + 1 + XY + XY + XY + XY$$

and applying Equation 2, XY + XY = 0, therefore the formula for the circuit is

It will be noted from Equation 4 that a change of either X or Y will change the entire circuit. This is the property for which the circuit is designed.

Function Theorems in Odd-even Algebra: A function of X is an algebraic expression containing the letter X. Even if the expression contains other letters, it can be considered as a function of X. Thus, for example, the expression X + Y + XY + 1 is a function of X, which is written

$$f(X) = X + Y + XY + 1$$

If this is the function of X that is meant, then by f(0) is meant the result found by letting X = 0 in f(X), thus:

$$f(0) = 0 + Y + 0 \times Y + 1 = Y + 1$$

Similarly, f(1) is found by letting X = 1 in f(X):

$$f(1) = 1 + Y + 1 \times Y + 1 = 0$$

where the reduction to 0 has been accomplished by noting that 1 + 1 = 0 and Y + Y = 0. The three foregoing equations are simply examples to illustrate the function idea and are not to be taken too seriously; thus, f(1) does not always equal 0, because f(X) is not always X + Y + XY + 1.

Any function of X in odd-even algebra can be ex-

Any function of X in odd-even algebra can be expanded by the following theorem:

Theorem 1: 
$$f(X) = Xf(1) + (X + 1) f(0)$$

This expansion theorem is verified by substitution of the only two possible values of X, viz. 0 and 1:

$$f(0) = 0 \times f(1) + (0 + 1) f(0) \dots (5)$$

$$f(1) = 1 \times f(1) + (1+1) f(0) \dots (6)$$

Using the laws of multiplication and addition, i.e., zero times any quantity is zero, one times any quantity is the quantity itself, zero added to any quantity is the quantity itself, and the sum of two like quantities is zero, the truth of Equations 5 and 6 is shown.

By multiplying both members of Theorem 1 by X and noting that  $X^2 = X$  and that  $X(X + 1) = X^2 + X = X + X = 0$  the following theorem may be derived:

Theorem 2: 
$$Xf(X) = Xf(1)$$

An inspection of Theorem 2 might tempt one to divide both members by X and thus conclude that all switches are closed. However, the fact that some switches are open, (X=0) prohibits division by X because, as in ordinary algebra, division by zero is to be avoided. Inasmuch as X has a good chance of being zero, division by X is to be avoided.

APPLICATION OF FUNCTION THEOREMS: The expansion theorem may be applied to circuit analysis as follows: Assume a circuit resembling the customary bridge circuit, as shown in Fig. 3. Let the formula for the circuit be f(X). By considering X closed, there results a circuit in which A and B in parallel are in series with C and D in parallel, so that by definitions 3 and 4 under Basic Vocabulary:

$$f(1) = (A + B + AB) (C + D + CD) \dots (7)$$

By considering X open, A and C in series are in parallel with B and D in series, so that

$$f(0) = AC + BD + ABCD \dots (8)$$

Putting Equations 7 and 8 into Theorem 1 the formula for the circuit is

$$f(X) = X(A + B + AB) (C + D + CD) + (X + 1) (AC + BD + ABCD) \dots (9)$$

After expanding and cancelling, the formula for the circuit can be written

$$BCX + ABCX + ADX + ABDX + ACDX + BCDX + AC + BD + ABCD \dots (10)$$

By successive application of the expansion theorem, the formula for any circuit can be found by considering one switch at a time.

Theorem 2 has a circuit interpretation by noting that if a switch X is in series with a circuit which contains other switches X, then the openness or closure of the entire system is unchanged by permanently closing all switches X except the original one. The truth of the foregoing is apparent when it is realized that if X is open the entire circuit is open and if X is closed, the permanently closed X switches agree with the "outside" X. Having discovered a circuit fact by algebraic manipulation, its validity can

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Table 1. Circuits Using Two Relays

	SPANDEUNIU	Con	dition is	Circuit	with
Circuit*	Formula	Y on	The second second	Y off	Y off
		Z on	Z off	Z on	Z off
	0	Off	Off	Off	Off
-r'z'-	1+ Y + Z + YZ	Off	Off	Off	On
-r'-z-	Z+YZ	110	Cff	On	Off
	1+7	Off	Off	On	On
-YZ'-	Y+YZ	Off	On	Off	Off
z'	1+2	Off	On	Off	On
らい	Y+Z	Off	On	On	Off
-C'Z'-	1 + YZ	Off	On	On	On
-r-z-	YZ	On	Off	Off	Off
-C'	1+Y+Z	On	Off	Off	On
z	Z	On	Off	On	Off
-C'2-	1+Y+YZ	On	Off	On	On
— r—	Y	On	On	Off	Off
	1+ Z+ YZ	On	On	Off	On
	Y+ Z+YZ	On	On	On	Off
	The state of the s	On	On	On	On

<sup>9</sup> The prime (\*) denotes a complementary switch which is open when its complement is closed and closed when its complement is open. Thus Y' is open when Y is closed, and vice versa.

Example: The notation being 1 = 0n and 0 = 0ff, the circuit for which the formula is Y + YZ is 0n because  $1 + 1 \times 0 = 1$  when Y = 1 (0n) and S = 0 (0ff).

be seen by elementary considerations. The algebraic manipulation, then, is an aid in ferreting out simple relationships which might otherwise be overlooked.

DERIVING A CIRCUIT FROM A GIVEN FORMULA: The final step in applying mathematical methods is to translate the symbolic result back into the physical system. In order to derive a circuit for a given formula, note that the formula in Theorem 1 is given by the circuit in Fig. 4, because the formula for Fig. 4 is obtained by applying definitions 3 and 4 under Basic Vocabulary:

$$X \times f(1) + (X + 1) f(0) + Xf(1) \times f(0) + Xf(1)f(0)$$
 .....(12)

$$Xf(1) + (X + 1)f(0)$$
 .....(13)

For any given formula the foregoing process can be applied successively for each switch by calculating f(1) and f(0) and substituting into the circuit of Fig. 4.

As an example, consider the formula X + Y + 1(Continued on Page 192)

Fig. 1—Left—Mechanical kidney replaces functions of human kidney where acute uremic poisoning exists

Fig. 2—Above—Closeup view of rotating joint on Kolff type

### Kidney Developed

Mechanical

BUILT of stainless steel, the mechanical counterpart of the human kidney shown in Fig. 1 was recently developed and built by Allis-Chalmers Mfg. Co. Of the type invented in 1944 by Dr. W. J. Kolff of Holland, it is about 51½ inches long, 42 inches high and 24 inches wide. It consists of a perforated drum which rotates at 18 rpm partially submerged in a bath of rinsing fluid containing primarily electrolytic salts. Both drum and bath are constructed of aluminum covered with a type of Vinylite. The unit is powered by a ¼-hp single-phase motor.

The drum is spiralled by about 140 feet of cellophane tubing through which the blood flows as the drum rotates. This tubing is actually sausage casing which permits certain sized molecules to flow through its walls. As the blood travels through the tubing, passing along always below the level of the bath water, the poisons, due to their molecular size, seep through the tubing walls into the rinsing fluid. The fluid must be changed every two hours to keep its poison concentration below that of the blood. Seepage of poison through the cellophane tubing from high to low concentration cleanses the blood.

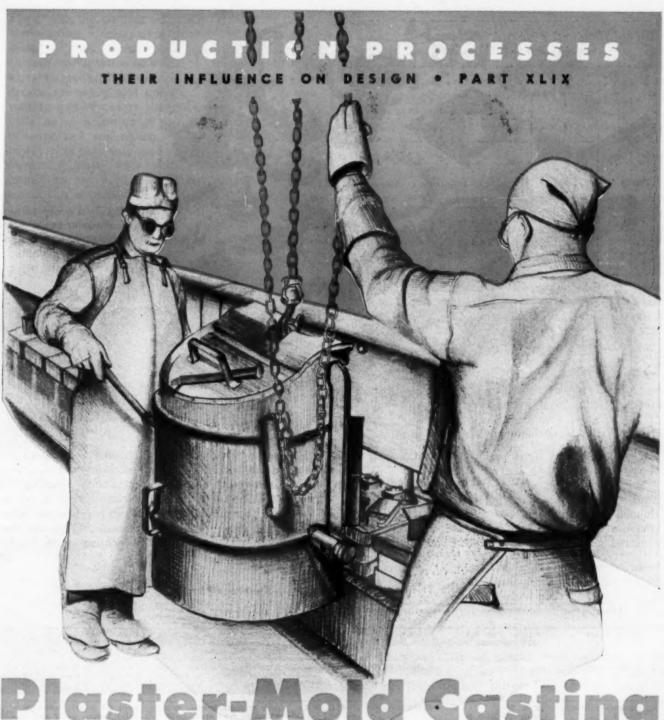
Interesting features of the new unit include a safety device for by-passing the blood in the event the cellophane tubing tears, a clutch appliance which permits the drum reel and pump to run separately,  $\pm$  one degree thermostatic control of the bath, a plastic cover for maintaining even temperature, and a hypodermic syringe which provides a rotating or slipring type of joint.

artificial kidney. Cellophane tube leads to patient

To form the rotating joint, Fig. 2, the ends of a hollow plunger in a hypodermic syringe were cut off, making the plunger a tube and the stationary member of the joint. This joint is fastened to the tube which leads to the patient. The body of the syringe rotates with the drum and is connected to the cellophane to provide an effective nonmetallic seal for the two rotating joints.

Two pumping actions are provided by the machine: one a pressure produced as the blood is worked along the bottom sections of the spiral winding by the drum's rotation; the other a milking action of a Beck type pump which returns the blood to the level of the patient. This latter action is accomplished by three cylinders mounted on a rotating unit which squeeze the tubing within the pump housing and at the same time roll the blood ahead of it. Capacity of the pump varies to 250 cc per minute depending upon the application. It changes the blood in the kidney completely about every two minutes.

While the blood flows through the mechanical unit, which is held within one degree of body temperature, it is kept from clotting by heparin. Allis-Chalmers engineers under the direction of Jack Wilson, chief physicist, and George Cassel of the firm's new product development department, handled the work on the kidney.



Plaster-Mold Casting

By ROGER W. BOLZ, Associate Editor, Machine Design

IMILAR in many general aspects to permanentmold casting, the plaster-mold process represents a further step in the search for the ideal mold medium. Used many centuries ago in fine arts for producing bronze statuary, plaster as a mold material for the production of castings on a commercial scale has only recently come into use. Developed largely during the past fifteen years, plaster-mold castings, Fig. 1, are now produced regularly in production quantities by four or more slightly differing techniques. PLASTER-MOLD PROCESS: In general, the various

methods of plaster-mold casting are similar. The plaster, also known as gypsum or calcium sulphate, is mixed dry with other elements such as talc, sand, asbestos, and sodium silicate. To this mix is added a controlled amount of water to provide the desired permeability in the mold. The slurry which results is heated and delivered through a hose to the flasks, all surfaces of which have been sprayed with a parting compound. The plaster slurry readily fills in and around the most minute details in the highly polished brass patterns. Following filling, the molds



Fig. 1—A group of typical nonferrous plastermold castings produced in quantity

are subjected to a short period of vibration and the slurry sets in five to ten minutes.

Molds are extracted from the flask with a vacuum head, following which drying is completed in a continuous oven, Fig. 2. Copes and drags which are of course necessary, are then assembled, with cores when required, and the castings poured. Upon solidification,

the plaster is broken away and any cores used are washed out with a jet of high-pressure water.

Advantages: The most outstanding advantage in use of plaster as a mold material, is that it can be varied in thermal capacity from an excellent insulator to a mild chill. Completely dehydrated plaster has no chill action and thus slow cooling of the metal

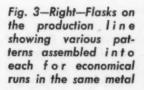
Table 1—Standard Plaster-Mold Casting Alloys

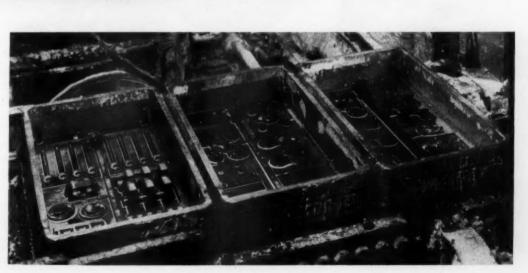
Alloy	Specifications	Tensile Strength (psi)	Hardness (Rockwell)	Characteristics	Applications
Yellow Brass No. 10	Similar Fed. Spec. QQB-726-Class D	55,000 to 70,000	55 to 75 B	High-strength brass, lowest in cost, good machining, high fatigue resistance.	Used for brackets, brush holders, frames, retainers, gears, levers, hardware.
Aluminum Bronze No. 20		75,000 to 85,000	56 to 80 G	High-strength, lighter than steel or other copper-base al- loys, high wear and corro- sion resistance.	Used for gears, sprockets, bearings, marine parts, dies pump parts, universal joints
Manganese Bronze No. 70	Fed. Spec. QQB-726-Class A Navy Spec. 49-B-3	∘65,000 to 80,000	60 to 80 B	High-strength bronze, good corrosion resistance, good ductility.	Used for levers, fasteners, valve bodies, gears and marine parts.
Manganese Bronze No. 100	Similar Navy Spec. 46-B-29 Class B	100,000 to 115,000	60 to 85 G	Super strength bronze, no heat treatment necessary, good ductility, good corrosion resistance.	Similar uses to No. 70 bronz where superior physical properties are desired.
Silicon-Aluminum- Bronze		59,000	65 to 75 B	High copper-silicon alloy, ex- cellent corrosion resistance and wearing qualities.	For outdoor applications, electrical parts, connectors, hardware, etc.
Nickel Brass (15 and 22% nickel)		50,000	80 to 90 B	Good ductility and corrosion resistance, white satin finish.	Used for corrosion resistant parts, dairy and food pro- essing machinery parts, loc parts, 22% nickel largely used in dairy & food equip- ment.
Aluminum Alloy No. 60	Alcoa No. 355 SAE No. 322	16,000 to 21,000 (as cast)	****	Casts in thin sections, no skin hardness, good for plat- ing, can be age hardened to 34,000 psi.	Used for instrument and similar parts where highest strength is not required.
Aluminum Alloy No. 375	(Universal)	****	****	High-strength alloy specially developed for plaster-mold casting, superior castability and physicals, good wear re- sistance.	Used where high strength and corrosion resistance is desired, for aircraft fit- tings, instrument parts, pump parts, pistons, cylin- der heads, etc.

along with the yielding character of the material prevents stress concentrations that might otherwise develop. Plaster molds permit accurate control of shrinkage, distortion or warpage being negligible. The surfaces produced are extremely smooth and the finest details are sharp and undistorted, Fig. 1. The selfventing and dry inert character of the mold creates little or no agitation of the metal, eliminating gas porosity and nonuniform density. Major limitation. however, is that only nonferrous metals may be cast. Generally, those with melting points over 1900 F cannot as yet be cast; the maximum temperature molds can withstand is about 2200 F. Experiments. however, are being carried on to adapt the process for other metals and in some cases bronze alloys with melting points as high as 2400 F have been successfully handled.

Patterns: Tooling cost or pattern cost is relatively

Fig. 2—Above—Finished plaster molds emerging from the continuous drying oven





low. The average pattern generally costs approximately \$150 to \$200. As the patterns are subjected only to the soft plaster being run over them, there is little abrasion, pressure or shock and consequently pattern life is practically unlimited. As changes are desired, it is usually possible to alter original patterns at low cost.

Patterns are made in split style, for cope and drag molds, and are mounted on precision machined unit strips in a standard flask, Fig. 3. Thus, numerous separate patterns can be arranged for casting simultaneously, reducing cost to a minimum. The patterns are accurately constructed and finished. Made from engraver's brass, patterns are held within a maximum variation of plus or minus 0.003-inch and are given a high polish. Because the plaster mold must be easily removable from the flask, pattern design must follow that found desirable for any casting method.

Size of Parts: Size of castings produced is of considerable importance owing to the need for a standardized production line. The standard flask size is 12 by 18 by 31/2 to 4-inches in overall depth. This size is most common and permits the casting of parts singly or in multiple from the smallest desired to the largest single piece which can be molded allowing a reasonable margin of plaster over the pattern. Straight partings are preferable and the maximum depth of pattern from the center parting line is 11/2 inches or a total, for a symmetrical part, of about 3 inches. Total depth may also depend upon the parting line. Where nonsymmetrical parts with other than a straight center parting are necessary, the greatest depth from one side only of the parting line is 2 inches. Parts weighing up to 15 pounds have been produced in these standard molds.

Parts too large for a standard mold are handled in oversize molds on a special semiautomatic production line. Oversize flasks used in present operations have been standardized as 10 by 18 by 2½ inches, 12 by 21 by 6 inches, and 24 by 36 by 12 inches. In special operations, machine parts up to 35 inches in diameter and weighing over 200 pounds have been successfully cast.

Production: Use of plaster-mold castings is relatively unlimited by quantity requirements. Volumes running from a few hundred pieces per year to several million pieces can be produced equally well. The unit strip flask system and standardized metals make small runs and even single parts for experiment feasible. Depending upon the design complexity, production per pattern per week on the unit strip plan runs about 150 to 250 pieces and with full plate of patterns this is increased to 300 to 450 pieces per pattern per week.

DESIGN CONSIDERATIONS: Most important feature of the plaster-mold casting process is the practicability of producing parts to exacting dimensions so that machining, finishing, balancing, etc., are almost totally eliminated, Fig. 4. Parts having internal splines, ratchet teeth, stops, blind gear teeth, airfoil-section blades, integral rivets, etc., which are ordinarily difficult and expensive to machine, can be readily produced, Fig. 5. Gears may be cast to regular machining accuracy so as to necessitate only a boring operation.

Draft: As with most casting methods, draft is required but with plaster-mold casting it is needed in order to facilitate withdrawal of the plaster mold from the patterns. Outside surfaces usually require a ½-degree draft angle and inside surfaces, ½ to 3 degrees. Holes or cavities formed by loose cores require no draft but integral core sections do.

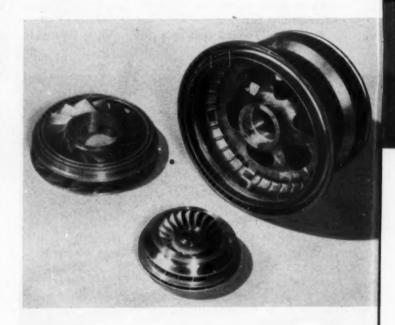
Cores: Several pieces can be consolidated into one part by means of separate core pieces but never by loose pieces on the pattern. Undercuts and intricate passages are readily produced, Fig. 6. Holes under ½-inch diameter normally can be drilled more economically than cored, Fig 7. Drill spots, however, can be placed on the pattern to eliminate fixtures.

Wall Thickness: Plaster, being a poor conductor of heat, is ideal for producing thin, sound walls. Where the area does not exceed 2 square inches, a wall of 0.040-inch can be cast. For larger areas the practical

minimum wall thickness increases, for 4 to 6 square inches a thickness of 0.062-inch being minimum and for areas up to 30 square inches the minimum is generally set at 0.093-inch. Tapering sections are readily producible and blade sections can be cast with knife-sharp edges.

Stock Allowances: Round, square or odd-shape holes may be cast with only a minimum of stock machining. Ordinarily where machining is required for any reason, in-inch metal allowance is sufficient but less can be allowed on small parts and cored holes, especially where broaching is to be used.

Markings and Inserts: Markings of almost any nature can be clearly reproduced. Lettering may be



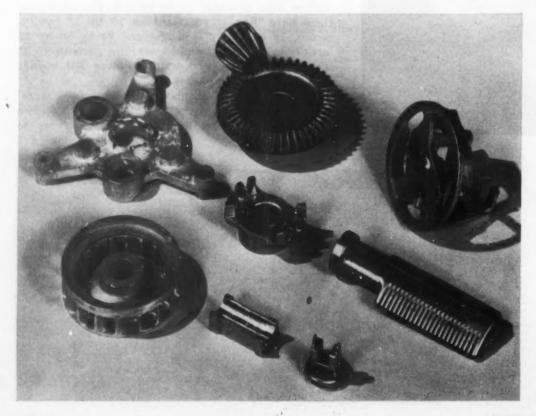


Fig. 4-Above - Upper left is a turbine for a torque converter mass produced. Upper right is a 10-inch aircraft wheel in which a metal saving of two pounds was made. Lower part is a 6-inch, 2-stage shrouded impeller which required critical balance accuracy for operation at 1500 fps peripheral speed and smooth internal surfaces. Vanes of impeller are held within 0.005-inch

Fig. 5—Left — Group of machine parts showing gear teeth, slots, vanes, ratchets, and cams

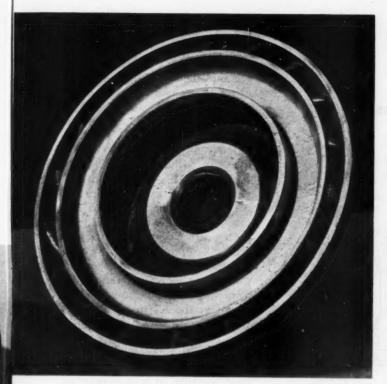


Fig. 6—Cast aluminum runner for automotive torque converter with intricate passages and sharp-edge blades

either raised or depressed as desired, Fig. 8. Additional features such as steel or other inserts may be cast-in with the usual considerations for galvanic action and sufficient strength to resist cracking of the casting on cooling.

MATERIALS: To effect maximum economy and satisfactory castings, metals suitable for plaster-mold casting have been developed and standardized. Lower scrap and efficient grouping of production patterns is effected by specifying one of the standard alloys. These alloys and their salient characteristics are given in Table 1.

In addition to these standard alloys almost any other castable metal in the noneferrous group can be cast if necessary, although at higher cost. Pure copper can be cast and beryllium-copper alloys produce excellent castings which have high physical properties and which will harden without warpage or relative dimensional change. Others possible include silicon-bronzes, nickel bronzes, nickel-copper, tin bronzes, and silicon-aluminum-bronze.

Tolerances: In general, a tolerance of plus or minus 0.005-inch per inch of dimension can be held. Where the dimension crosses the parting line the tolerance is increased to plus or minus 0.010-inch per inch. In specific portions of a casting, however, more exacting tolerances are practical. For instance, overall tolerances of plus or minus 0.005-inch for portions within one half of a mold and plus or minus 0.010-inch where the dimension crosses the parting line are being commercially produced today.

Cored dimensions within a casting can also be held to plus or minus 0.005-inch per inch. Center-to-center dimensions of holes produced by separate cores can be held to the same limits. Tolerances on integralcore portions must take into consideration the draft angle which is required.

Flatness of surface which can be obtained depends to some extent upon the casting design. As a rule, areas of roughly one square inch are readily held flat within 0.005-inch. Larger surfaces, say approximately six square inches, may sustain a warpage ranging from 0.007 to 0.015-inch depending upon design.

Surface roughness in production can be consistently held to 30 microinches, rms, or better. The velvetsmooth surfaces produced are eminently suited for any parts which are to be electroplated.

Collaboration of the following organizations in the preparation of this article is acknowledged with much appreciation:

Atlantic Casting & Engineering Corp. Clifton, N. J. Beryllium Corp. of Pa. Reading, Pa. Eclipse-Pioneer Div., Bendix Aviation Corp. Teterboro, N. J.

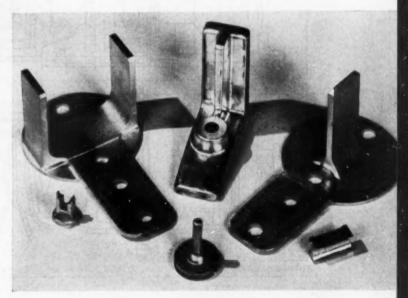
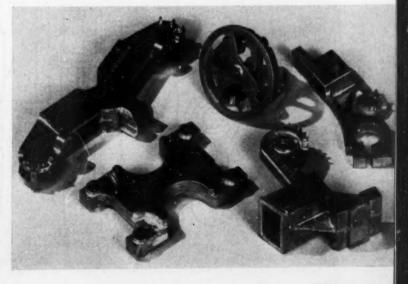


Fig. 7—Above—Several parts of odd shape in which the holes have been cored

Fig. 8—Below—Machine parts on which identifying markings can be seen. Depressed lettering is most economical owing to ease in stamping markings into brass patterns



### Centrifugally Controlled Drive

. . for motor-bike transmission

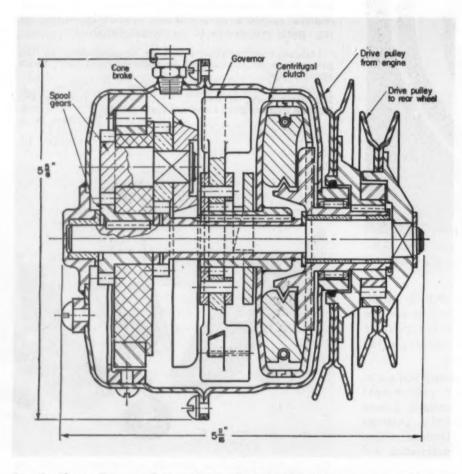
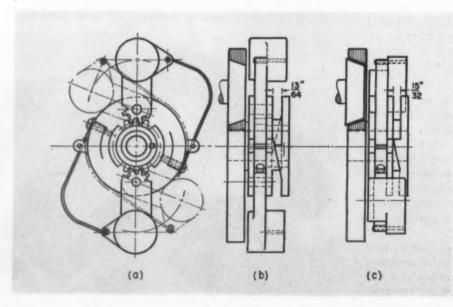


Fig. 1—Above—Two-speed transmission shown in direct-drive position with cone brakes and spool gears locked



STEPLESS speed variation in automatic, two-speed transmission for motor-bikes, or other similar applications, is accomplished in a compact unit using three sets of spool gears and three small cone brakes in conjunction with a centrifugal clutch. Shifting from a 1.7 to 1 low-gear ratio to the 1 to 1 direct-drive ratio is obtained automatically as the speed of the motor-bike increases. Operation of the transmission is as follows: Engine input is to a drive pulley direct connected to a centrifugal clutch which slips under engine idling conditions. As engine speed increases, the clutch gradually engages and delivers power at the 1.7 to 1 gear ratio through the three spool gear sets to the output drive shaft.

When the engine speed reaches a preset limit, centrifugal weights in a governor on the input side of the transmission rotate a cam to engage a brake disk with the three braking cones. Since these braking cones are mounted on the ends of the three spool gear shafts, stopping of the rotation of the spool gears gradually increases the gear speed ratio from 1.7 to 1 to that of direct-drive.

The drawing of the transmission, Fig. 1, shows the unit in the high gear or direct-drive po-Governor weights are fully extended, the cone brakes are completely locked and the spool gears are not increasing torque. Fig. 2 shows the governor weights in extended (solid lines) and retracted (dotted lines) positions at a. brakes are shown in the locked condition, as in direct drive, at b, and in c the weights are in the collapsed position with the cone brakes unlocked and spool gears free to rotate, as in the low-speed condition. The transmission, manufactured by Powermatic Inc., Akron, O., results in a torque increase of approximately 70 per cent in going from the high to low-gear ratios.

Fig. 2—Left — Governor mechanism mounted on input shaft to transmission which actuates the braking disk to lock the cone brakes

# Electronic Regulators and Regulating Systems

By W. G. Roman Westinghouse Electric Corp. Buffalo, N. Y.

est use in the continuous process industries such as steel, paper, rubber, packaging and printing. Regulators inherently operate continuously or very repetitively. Thus, they impose severe duty on any electromechanical device. The use of electronic circuits to perform the precision and repetitive functions materially improves the performance and reliability of the regulator. Many regulating problems such as automatic color register on multicolor presses could not be solved except electronically.

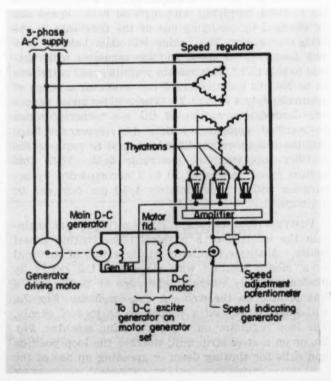
Process regulators can be conveniently divided into four classes:

- 1. Quantity
- 2. Position
- 3. Quantity matching
- 4. Position matching

QUANTITY REGULATORS: These devices regulate the magnitude of variables such as voltage, current, frequency, speed and temperature.

A typical speed regulator of this class, Fig. 1, would consist of a d-c motor, a motor-generator set for supplying the power to the motor, an electronic regulator, and an a-c tachometer generator coupled to the motor for indicating the speed. The motor

Fig. 1—Electronic speed regulating system can hold speed variations within accuracy of 1/10 per cent over range of 4 or 5 to 1



This article is based on a paper presented at AIEE Conference on industrial Application of Electron Tubes, Buffalo, April 11 and 12.

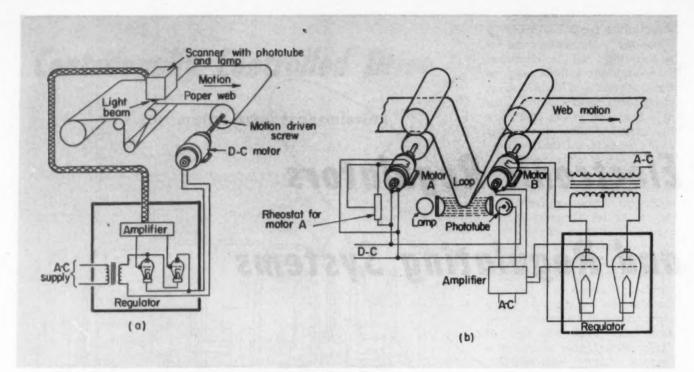


Fig. 2—In both edge regulator (a) and loop regulator (b), phototube is used to sense shifts in position of material

field would be supplied with a constant voltage by means of an exciter. Generator field current and therefore the power supplied to the motor armature is regulated by the electronic exciter. Motor speed is indicated by the a-c tachometer whose output voltage and frequency is proportional to speed. The tachometer voltage is applied to a frequency-sensitive bridge network. When the tachometer frequency differs from the frequency for which the bridge is balanced, a small signal voltage appears across the bridge.

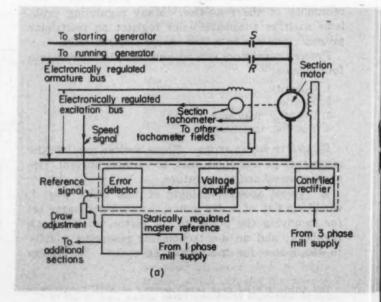
This signal voltage is amplified and used to control the rectifier supplying the generator field. Speed can be changed by changing one of the constants in the bridge network. The bridge will then balance at a new frequency or speed and the regulator will regulate to this point. This system permits speed variations to be held to less than 1/10 per cent over a range of approximately 4 or 5 to 1. Where wider speed ranges are desired, the output of the a-c tachometer can be rectified, compared with a d-c reference voltage and the difference amplified and used to regulate the rectifier supplying the generator field. With this system speed ranges of 10 to 1 accompanied by accuracies within approximately 1/10 per cent can be maintained.

Position Regulators: Position regulators maintain the location of a physical object within preset limits. A slitter regulator guides a web of material to a chosen location with respect to the cutter by photoelectrically watching the edge of the web or a line printed on the web. A similar device, Fig. 2a, will guide a web on a winder so as to reel evenly. The loop regulator on a paper-coating machine, Fig. 2b, or on a steel strip mill, watches the loop position and calls for slowing down or speeding up one of the

sections of the mill to maintain a constant loop. An increase in the length of loop reduces the amount of light reaching the phototube from the light source. The change in phototube current is amplified and used to modify the field excitation of the motor driving one section of the line. This changes the motor speed and brings the loop back to its proper position.

QUANTITY MATCHING REGULATORS: These regulators are used to insure that two or more quantities match each other. Frequently, it is desired to adjust the speed, voltage, current, or frequency of one element of a system and have one or more additional elements equal or bear a chosen relation to the first element. This is especially important in continuous processing lines such as steel, paper, rubber and photographic film.

An important example of this type of regulator is



the paper mill section drive regulator, Fig. 3a. In this system, the speed of each section of the paper mill is regulated to a preset ratio with respect to the speed of a master reference. The armature power for all of the section drive motors as well as the motor of the master reference set is furnished from a main motor generator. The overall mill speed is adjusted by the control of the field of the main set.

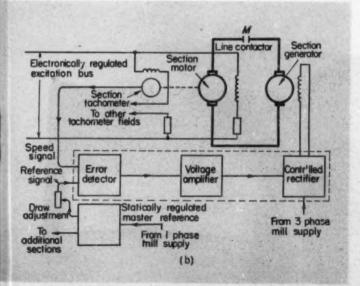
#### Regulator Compares Speed with Tachometer

A cue tachometer is attached to each section drive motor. The regulator consists of a separate regulating circuit for each section of the mill. For each section, the regulator compares the speed indication from the master reference with that from the cue tachometer for that section. The regulator supplies the correct field current to each section driving motor to maintain a chosen speed ratio between the master and the section. An accuracy of match within 1/10 per cent is maintained.

Position Matching Regulators: A regulator is frequently used in the paper, cellophane, and glassine packaging industry for maintaining the position of cut when taking stock from a preprinted roll to make bags and packages. Although the machine feeds paper at a rate approximately correct to match the speed of the cutter knife, the cut will never remain registered perfectly without either manual or automatic supervision. A register regulator, Fig. 4, corrects for minor changes due to paper slippage, stretch, and proper speed relative to the cutter speed. The position of the printed material is indicated by a rectangular register mark in the design or margin which is scanned by a phototube. Position of the mark with respect to the cutter is checked and the speed of the paper feed modified as necessary.

Another important application for this class of regulator is for maintaining the register of the sev-

Fig. 3—Electronic paper-mill section regulators match speeds of various sections within accuracy of 1/10 per cent. Single-generator drive is shown at (a); multiple-generator drive is shown at (b)



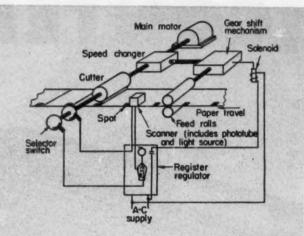
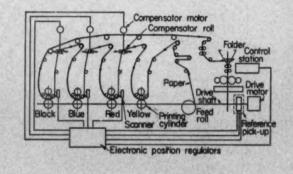


Fig. 4—Above—Single-direction register regulator for bag machine in which signals from scanner control paper feed units to insure proper positioning

Fig. 5—Below—Multicolor press register regulator insures register accuracy within 0.003-inch

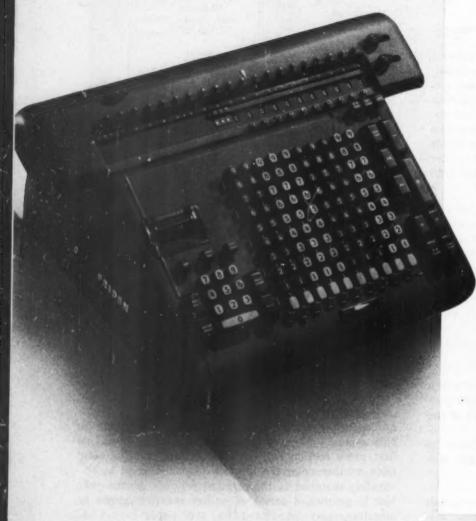


eral colors in a multicolor printing press, Fig. 5. In this system, yellow is printed by the cylinder in the first press section and each succeeding press section adds another color the location of which must be accurately matched to the original yellow. As the yellow is printed, a series of yellow register marks is simultaneously imprinted on the paper web. A scanner at each succeeding press section detects the position of the yellow register mark. The regulator then compares the scanner signal with that from a reference pickup attached to the printing cylinder and makes adjustment of the loop of paper between cylinders to match the time occurrence of the two signals. A register accuracy within approximately three thousandths of an inch is maintained.

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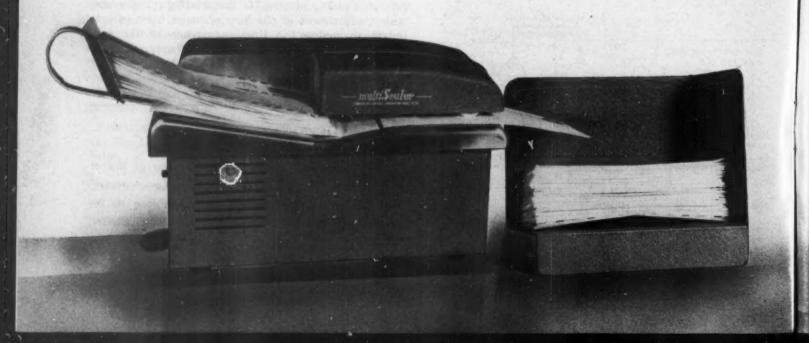


#### ... as represented by modern b

Fully automatic multiplication, division, addition and subtraction features make this Friden calculator, left, a time-saver in engineering, accounting, statistical, and other office figure work. Machine is "color-engineered" to reduce operator fatigue and includes special-shape Tenite keys for additional ease of operation. Both 8 and 10-bank models are available. Manufacturer: Friden Calculating Machine Co., San Leandro, Calif.

Envelopes, below, features a water feed which assures a uniform flow of water to the gummed flap. All excess water is returned to the tank. A rubber belt accurately feeds the envelopes at high speed under the metal sealing blade. As in the companion envelope opener, self-lubricating bearings contribute to smooth and quiet operation. Manufacturer: Commercial Controls Corp., Rochester, N. Y.

Envelope opener, below, right, for automatically opening and stacking thousands of letters per hour. Dial may be set for light, medium or heavy cut. The accurate feeding mechanism of the opener assures uniform cutting along the full length of the envelope without damage to the contents. The machine is styled in a



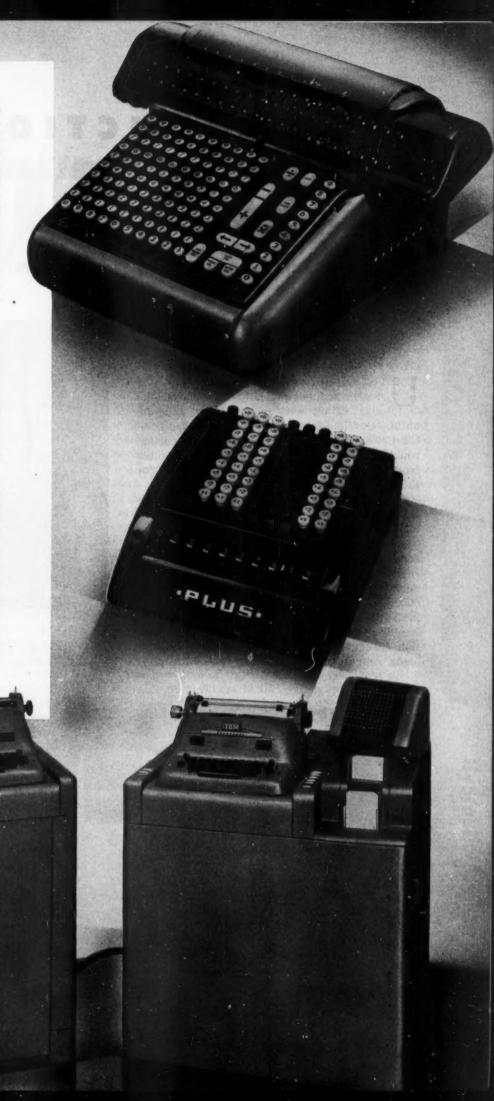




of the cards and typing of the information desired in the correct position on the document. The machine can be programmed to stop at any given time to allow the operator to type in variable information. When desired, a second typewriter can be connected to the basic unit for the automatic preparation of a different type of document requiring the same information. Simultaneously with the typing operation, a transmittal tape can be punched to permit cards to be made containing the same information as was typed on the documents. Manufacturer: International Business Machine Corp., New York, N. Y.

Key-actuated type adding machine, center, right, permits rapid addition, multiplication and subtraction because of direct key-to-dial registration. Keys are banked for fast and comfortable operation, with the "1" and "9" keys specially placed to permit easier locating. Nine-column models weigh 14 pounds with one-piece steel cases. Manufacturer: Plus Computing Machines Inc., New York, N. Y.

Figuremaster calculator for engineering and commercial use, top, right, solves the question of where the decimal point should be placed in division. At the completion of the problem the carriage automatically positions itself and points off the decimal. The top surfaces of the Tenite keys are slanted to create a step effect on the keyboard, minimizing the chances of accidentally depressing two keys at once. Columnar divisions of the keyboard are indicated by colored keys. Manufacturer: Marchant Calculating Machine Co., Oakland, Calif.



# PRODUCTION AND DESIGN

#### Modern Practices in Manufacture

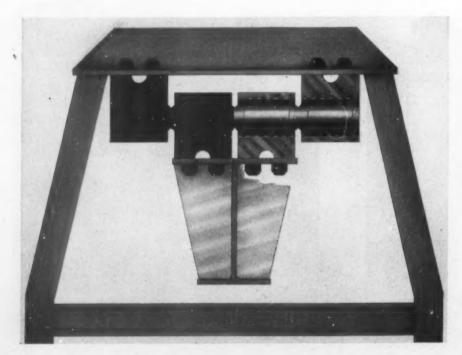
#### Design with Rubber

TILIZATION of a rubber bearing mounted rocker arm has radically simplified the design of oil well reciprocating pumping units. Developed jointly by United States Rubber Co. and Cabot Shops Inc., the new bearing, which is used in the evener assembly, reduces from 100 to 38 the number of parts required for the pumping unit.

Field tests in west Texas, Panhandle and Louisiana oil fields have shown that the rubber bearing provides more than 200 per cent greater wear life than the standard installation using a conventional mounting with needle bearings. The rubber evener bearing, under unusually severe operating conditions, completed more than 40,000,000 cycles, outwore many of the structural metal parts in the unit and still maintained serviceable operating conditions. It was also found that the rubber bearing greatly reduced shock loads compared to the standard type bearing.



View of the Cabot oil well pumping unit equipped with rubber evener bearings on test on a 3500-foot well in Texas



In addition to the economies effected by the simplification of pumping unit design and longer wear, rubber was selected for bearing construction for the following reasons: To eliminate lubrication since the assembly needs no sliding or rolling parts, to obtain corrosion and abrasion resistance, to insulate the drive from well shocks, to eliminate the need for elaborate assembly, to provide for misalignment, and to obviate initial friction and excessive wear.

Left—Cross section through the evener bearing assembly showing the four rubber bearings and simplified assembly design

# Hydraulic Standards

# Hydraulic Packings for Industrial Equipment

By J. N. Smith

Manager

Hydraulic and Transmission Div. E. F. Houghton & Co. Philadelphia, Pa.

STANDARDIZATION of hydraulic packings by sizes and types, to simplify selection and reduce sizes and inventories, has been worked out over the past year by the manufacturers of packings under the auspices of the Joint Industry Conference on Hydraulic Standards for Industrial Equipment. This is primarily an attempt to aid designers, and users of packings, rather than merely to alleviate problems of the packing suppliers. Firms who build or utilize hydraulically operated equipment and experience considerable difficulty in stocking original or replacement packings for such units should find this new development of distinct value.

Experience with packing designs over many years has shown that the sealing of hydraulic elements is too often the last consideration. Because of confusion or lack of the necessary information, common drawing practice has been to leave a space to indicate some sort of packing installation, a packing manufacturer being consulted for recommendations after all other phases of the design had been worked out. One possible result was ineffective design; a definite result was a multiplicity of special sizes.

Of five basic packing designs—U, V, Cup, Flange, and O-ring—each equipment manufacturer over the years had built up his own list of sizes required, and there was little uniformity between them. Recommended diameters and cross-sections varied widely and interchangeability was impossible. In specifying packings, it was necessary to give complete dimensions rather than simple standard numbers.

To release machine hydraulics development from these severe stumbling blocks it was fully appreciated that standardization was both desirable and necessary. Starting with the Army-Navy (AN) packing specifications for aircraft, established during the war, the JIC project was developed to cover all types and sizes of leather and synthetic rubber packings. The results, which are based on a plan set up by Houghton engineers, are set forth in the tables of this Data Sheet.

Packings of one basic style or design, with few

exceptions, have the same proportions and are therefore interchangeable. One variation is found in fabricated V-packings, where manufacturers' varying designs cause differences in stack heights. However, by slight modification the overall height per set can be predetermined. Most important is the fact that diameters and cross-sections are standard for all V-packings.

Along with standardization of various types and sizes, standard dash numbers have been established to facilitate specifying and ordering. No dimensions need be used, except with cups where the hole may vary, and it is only necessary to order a specific "Dash Number" by type and specify the service. The same dash number applies to the same size packing in both fabricated and leather cup styles, and also to leather, fabricated or homogeneous synthetic rubber V-packing. The number of sizes has been greatly reduced. Thus, fewer molds are required and greater economy is obtained. In addition, inventories of packings will be greatly simplified and prompt deliveries can be assured.

The last item of importance to the designer and to the user of packings is the coding system which at this writing is nearing completion. This system comprises the use of a metal plate, similar to the type commonly used for lubrication instructions on a machine, on all hydraulic units to convey the specifications of the packing used. This makes reordering much easier, and removes the necessity of tearing down the unit to determine size and style of packing required. The code will have symbols to be struck into the soft metal plate showing: (1) Type of packing material (leather or homogeneous or fabricated synthetic rubber), (2) design (U, V, Cup, Flange or O-ring), and (3) standard dash number to indicate exact size. All these sizes and dash numbers are being set up to tie in with AN sizes where dash numbers are already in use, so there can be no confusion between commercial and AN standards.

There are still a few details to be worked out on coding, stack height, stuffing box design, etc., but the major job has been done, and when understood and followed it should prove of definite advantage to all users of packing, and to the hydraulic industry generally.

#### HYDRAULIC AND PNEUMATIC

#### PACKING STANDARDS

Leather and Synthetic Rubber

OD

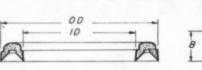
#### Recommended Number of V Packings per Set

Pressure (psi)	Leather	Synthetic Homogeneous	
Zero to 500	. 3	3	3
500 to 1500	. 4	4	4
1500 to 3000	. 4	5	4
3000 to 5000	. 4	6	5
5000 to 10,000			6
10,000 and over	. 6		

18

All V packings should be made solid (not split).

#### STANDARD SIZES FOR FABRICATED V PACKINGS



B

.156

.156

.156

.156

.156

.156

.156

.156

.156

.188

.188

.188

.188

.188



ID

21

2¾

31 31

Cross Section

なるなななな

В	53 54 55 56 58	To To de	5 51 51 51 51 6	54 64 64 7	.25 .25 .25 .266 .266
.188	60	à	61	75	.266
.188	62	ā	7	8	.266
.188	64	1	73	81	.266
.188	66	1	8	9	.266
.188	67	1	81	91	.266
.188	68	à	9	10	.266
.219	69	1	91	101	.266
.219	70	1	10	11	.266
.219	71	1	101	113	.266
.219	72	à	11	12	.266
.219	74	3	12	13	.266
.219	76	à	13	14	.266
.25	78	à	14	15	.266
25	80	1	15	16	266

ID

42

OD

.25

.25

NOTE: The above are standard commercial sizes recommended for new Other sizes for equipment already in use are available.

I.D. (Nom)

#### PROPORTIONS FOR FABRICA



AIED	V PACI	(INGS					
Cross Section	A	В	D	Cross Section	A	В	D
10 10 10 10 10	14 14 18	.109 .156 .188 .219	16 91 24 24	1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1	254 254 p.m. p.m. p.m.	.438 .469 .50 .531	91 91 91 91
10 1	8	.25 .266	33	18	1	.563 .594	33
1,6	18 18	.266 .213	# 15 35	1 % 14 1 %	18 18 11	.625 .656	18 11
111	8	.344 .375	10	18 1 7 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1	11 12	.688 .719	1 1/3
18	9	.406	13	11	18	.75	137

NOTE: Each set consists of male and female adapters and necessary number of packings to equal required depth.

#### STANDARD SIZES FOR HOMOGENEOUS V PACKINGS

.083

.083

.083 .083

.083.083

.083

.083

.083

.140

.140



28 29 30	18 18 18	15 12 17	21 28 21	.140 .140 .140	53 54 55	18 18 18	5 51 51	57 61 62	.197 .197
31 32		2 21	28 23	.140	56 . 58	10	5½ 6	6½ 7	.197 .197
33 34	18 18 18 18	21 21	21	.140	60 62	3	6½ 7	7½ 8	.197
35	16	21	31	.140	64 66	1	7½ 8	81	.197
36 38	200	2½ 2¾	31	.156	67 68	1	81	9½ 10	.197
40 42 44	3	3	34	.156 .156 .156	69 70	1	9½ 10	10½ 11	.197
46	3	31 31	41	156	71 72	1	101	11½ 12	.197
49 50	18	4	43 51	.197	74 76	1 1	12 13	13 14	.197
51	20	44	58	.197	78	1	14	15	197

B ±.010

.197 .197 .140 NOTE: The table shows standard commercial sizes recommended for new designs. Oth 49 tabulated sizes, together with the 31 intermediate dash numbers, correspond to AN-6225.

Dash

Cross Section

A

ID

#### STANDARD SIZES FOR LEATHER V PACKINGS -

			00	909	7	ross ection	nlorged lection			Dash No.	Cross Section	I.D. (Nom)	0.D. (Nom)	B ±.010
Dash No.	Cross Section	I.D. (Nom)	O.D. (Nom)	±.010	Dash No.	Cross Section	I.D. (Nom)	O.D. (Nom)	±.010	54 55 56	16	51 51 51	61 62 61	.197 .197 .197
8 10 12	1	14 88	8146	.083 .083 .083	31 32	18 18 18	2 21	28 23	.140	58 60 62	à	6 6 7	7 71 8	.197 .197
14 16	1 1 1	PE 30	18 11	.083	33 34 35	16 16 16	21 28 21	2	.140 .140 .140	64 66	10 10	7à	81	.197
18 20	1	1	18 13	.083	36 38	98	2½ 2¾	31 31	.156 .156	67 68	à	8½ 9	9½ 10	.197
22 24 25	18	11 11 11	19 12 13	.083 .083 .140	40 42 44	200	3 31 31	31 4 41	.156 .156 .156	69 70 71	10 10	9½ 10 10½	10½ 11 11½	.197 .197 .197
26 27	18 18	18 11	2 21	.140 .140	46 49	2,4 8	39 4	41 42	.156 .197	72 74	à	11 12	12 13	.197
28 29 30	18 18 18	19 19 17	21 28 21	.140 .140 .140	50 51 52	18 18 18	41 41 42	5± 5± 5±	.197 .197 .197	76 78 80	1	13 14 15	14 15 16	.197 .197 .197

NOTE: The above are standard commercial sizes recommended for new designs. Other sizes for equipment already in use are available.

#### STANDARD SIZES FOR HOMOGENEOUS U CUP PACKINGS-

			Enlar	ged Section		Dash No.	W&L	I.D. (Nom.)	O.D. (Nom.)	Diamet	ters ± .005
	8	A_A				24 25	1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1	1½ 1½	13 17	1.265 1.265	1.735 1.860
Dash No.	W&L	I.D. (Nom.)	0.D. (Nom.)	iland width Diamet	ers ± .005	26 27 28 29	18 18 18	10 11 15	2 2 2 2 2 2 2 2 3	1.390 1.515 1.640 1.765	1.985 2.110 2.235 2.360
40.	***************************************	(240111.)	(140111.)	•	8	30	18	19 17	21	1.890	2.485
8 10 12 14 16		446 000 404 000 034	7 1 11 11	.265 .390 .515 .640 .765	.735 .860 .985 1.110 1.235	31 32 33 34 35	18 18 18 18 8 18 8	2 2½ 2½ 2½ 2½ 2½	25 24 25 3 3	2.015 2.140 2.265 2.390 2.515	2.610 2.735 2.860 2.985 3.110
18 20 22	**	1 1	18 13 18	.890 1.015 1.140	1.360 1.485 1.610	36 38 40	90 90	2½ 2¾ 3	31 31 32	2.515 2.765 3.015	3.238 3.488 3.738

Note: The table shows standard commercial sizes recommended for new designs. The 23 tabulated sizes, together with the 30 other dash numbers in the range from 1 to 53, correspond to AN 6226.

#### STANDARD SIZES FOR LEATHER U PACKINGS

		-	D	13	0°	Dash No.	Cross Section	ID	op	c	E
U		1		9		42	1	31	41	à	h
IC	ross	0				44	2	31	41	2	h
S	ection	0 -	_			46	à	33	49	à	ì
-			0	_		49	9	4	51	8	10.
						50	8	41	51	8	183
No.	Cross Section	ID	OD	C	E	51	9	41	- 59	8	51 52 53 53 53 54 54
-	эссион	145	00			52	R	43	6	R	v6
12	4	3	1 .	18	19. 19.	53	9	5	61	8	AA.
14	1	9	11	YA	Tr.	54	9	51	64	8	nA.
16	1	3	11	18	1	55		51	69	9	AA.
18	1	Z	18	18	10	56	8	ol	61 61 7	ä	A
20	9	1	19	8	A						
22	2	11	17	- 8	8 2 8 2	58	2	6	71	3	10
					-	60	4	61	8	2	10
24	8	11 18	2	8	82	62	4	7	81	4	TÎ.
26 27	8	18	21	8	33	64	2	73	9	2	77
27	8	11	21	8	33	66	9	8	93	9	ri
28 29	8	19	28	8	2/2	67	9	81	10	3	44 44 44 44 44
29	8	• 13	21	8	alla.		8		101	3	
30	- 1	17	27	18	à	68	3	9	101	4 3	n
1	1				1	69	- 4	91	11	3	15
7	2	2 2 2 3 2	3	14 14 14 14	8	70	3	10	113	4	13
31 32 33	2	28	31	18	8	71	4	101	12	4	1,5
33	8 -	21	31	1.6	8	72 74	- 4	11	121	4	10 10 10 10 10 10 10 10 10 10 10 10 10 1
34	9	28	31	7.0	. 8	74	3	12	131	1	1,9
36	9	28 21 22	31	1	8	76	8	13	141	1	rh
38	9	24	34	à	à	78	3	14	151	1	n
10		3	4	1	1	80	8	15	165	-	Ti

NOTE: The above are standard commercial sizes recommended for new designs. Other sizes for equipment already in use are available.

#### STANDARD SIZES FOR O RING PACKINGS.

F	Flash no	of to exce	ed .003 thick	high Enlarged	Section	Dash No.	w	ID	op	w	ID
0	À	, 200		0 //	W (actual) to	41	Ye.	31	31	.210±.005	3.100 ± .018
1	2				be taken at	42	2gr	31	31	$.210 \pm .005$	$3.225 \pm .013$
		_ 10			base of flash	43	18	38	33	$.210 \pm .005$	$3.350 \pm .013$
	-	- m	-	-W-		44	The	34	37	$.210 \pm .005$	$3.475 \pm .013$
		00		-		45	19	38	4	$.210 \pm .005$	3.60001
						46	18	32	44	$.210 \pm .005$	$3.725 \pm .013$
Dash								-			
No.	W	ID	OD	W	1D	47	18	34	41	$.210 \pm .005$	$3.850 \pm .013$
1	10	1	1	.070±.003	.114±.005	48	Age.	4	48	$.210 \pm .005$	$3.975 \pm .013$
2	18	2/2	27	$.070 \pm .003$	$.145 \pm .005$	49	18	41	43	$.210\pm.005$	$4.100 \pm .01$
3	18		78	$.070 \pm .003$	$.176 \pm .005$	50	To	41	48	$.210\pm.005$	$4.225 \pm .01$
4		1,4		$.070 \pm .003$	.208±.005	51	ng.	48	43	$.210\pm.005$	$4.350 \pm .013$
5	1,8	22	33	$.070 \pm .003$	.239±.005	52	2,9	43	47	$.210 \pm .005$	$4.475 \pm ,013$
	1,8	3,	8			53	1	49	54	$.275 \pm .006$	$4.600 \pm .013$
6	1,a	Age .	Aga	$.070 \pm .003$	$.301\pm.005$	54	1	49	51	$.275 \pm .006$	$4.725 \pm .013$
7	10	a	à	$.070 \pm .003$	$.364 \pm .005$	55	3	47	58	$.275 \pm .006$	4.850 ± .01
8	10.2	. 8	X or	$.103 \pm .003$	$.362 \pm .005$	56	1	5	58	$.275 \pm .006$	$4.975 \pm .018$
9	n/h	170	R	$.103 \pm .003$	$.424 \pm .005$	57	1	51	59	$.275 \pm .006$	5.100 ± .02
10	n/h	à	11	$.103 \pm .003$	$.487 \pm .005$	58	1	51	59	$.275. \pm 006$	$5.225 \pm .023$
11	272	101	ą	$.103 \pm .003$	$.549 \pm .005$		4	-	-		
12	2/2	n	18	$.103 \pm .003$	$.612 \pm .005$	59	4	58	51	$.275 \pm .006$	$5.350 \pm .023$
13	n/a	11	Ā	$.103 \pm .003$	$.674 \pm .005$	60	4	54	6	$.275 \pm .006$	$5.475 \pm .023$
				$.103 \pm .003$	$.737 \pm .005$	61	4	58	61	$.275 \pm .006$	$5.600 \pm .023$
14	23	3	18		$.734 \pm .006$	62	1	53	61	$.275 \pm .006$	$5.725 \pm .023$
15	8	3	1	$.139 \pm .004$		63	1	54	61	$.275 \pm .006$	$5.850 \pm .023$
16		7.9	110	$.139 \pm .004$	$.796 \pm .006$	64	1	6	6 à	$.275 \pm .006$	$5.975 \pm .023$
17	å	W.	14	$.139 \pm .004$	$.859 \pm .006$	65	3	61	63	$.275 \pm .006$	$6.225 \pm .023$
18	8	18	1 18	$.139 \pm .004$	$.921 \pm .006$	66	1	64	7	$.275 \pm .006$	6.475±.023
19	à	1	13	$.139 \pm .004$	$.984 \pm .006$	67	1	63	71	$.275 \pm .006$	$6.725 \pm .023$
20	à	1 %	1 1/4	$.139 \pm .004$	$1.046 \pm .006$	68	1	7	75	$.275 \pm .006$	6.975±.023
21	h	14	18	$.139 \pm .004$	$1.109 \pm .006$	69		71	73	.275±.006	$7.225 \pm .030$
22	ă.	13	1,7	$.139 \pm .004$	$1.171 \pm .006$	70	1	75	8	.275±.006	7.475±.030
23	à	11	16	$.139. \pm 004$	$1.234 \pm .006$		4	_	_		
24	à	17	178	$.139 \pm .004$	$1.296 \pm .006$	71	4	79	81	$.275 \pm .006$	$7.725 \pm .030$
	-				$1.359 \pm .006$	72	4	8	81	$.275 \pm .006$	$7.975 \pm .030$
25	à	18	18	$.139 \pm .004$		73	4	81	9	$.275 \pm .006$	$8.475 \pm .030$
26	à	1 70	114	$.139 \pm .004$	$1.421 \pm .006$	74	1	9	91	$.275 \pm .006$	$8.975 \pm .030$
17	à	11	19	$.139 \pm .004$	$1.484 \pm .006$	75	1	91	10	$.275. \pm 006$	$9.475 \pm .030$
28	The .	13	17	$.210 \pm .005$	$1.475 \pm .010$	76	1	10	101	$.275 \pm .006$	$9.975 \pm .030$
29	Ag.	18	2	$.210 \pm .005$	$1.600 \pm .010$	77	1	10%	11	$.275 \pm .006$	$10.475 \pm .030$
10	rb.	19	21	$.210 \pm .005$	$1.725 \pm .010$	78	1	11	111	$.275 \pm .006$	$10.975 \pm .030$
1	1 <sup>8</sup> c	13	21	$.210 \pm .005$	$1.850 \pm .010$	79	1	113	12	$.275. \pm 006$	11.475 : .035
2	XH	2	28	$.210.\pm 005$	$1.975 \pm .010$	80	1	12	123	$.275 \pm .006$	$11.975 \pm .035$
3	18	21	21	$.210 \pm .005$	$2.100 \pm .010$	81	1	128	13	.275±.006	$12.475 \pm .035$
4	19	21	28	$.210 \pm .005$	$2.225 \pm .010$	82	1	13	131	$.275 \pm .006$	$12.475 \pm .035$ $12.975 \pm .035$
5	10	28	29	$.210 \pm .005$	$2.350 \pm .010$		-		-		
6		24	27	$.210 \pm .005$	$2.475 \pm .010$	83	1	131	14	$.275 \pm .006$	13.475±.035
-	Ag.	_	-			84	1	14	143	$.275 \pm .006$	$13.975 \pm .035$
7	The .	28	3	$.210 \pm .005$	$2.600 \pm .010$	85	1	143	15	$.275 \pm .006$	$14.475 \pm .035$
8	n <sup>2</sup> x	29	31	$.210 \pm .005$	$2.725 \pm .015$	86	1	15	151	$.275. \pm 006$	$14.975 \pm .035$
9	The state of	27	31	$.210 \pm .005$	$2.850 \pm .015$	87	1	151	16	$.275 \pm .006$	15.475 ± .035
0	x'br	3	31	$.210 \pm .005$	$2.975 \pm .015$	88	1	41	5	$.275 \pm .006$	4.475±.015

Note: See table on opposite page for information on leather back-up washers used with O-ring packings. Dash numbers correspond with AN-6227 sizes.

#### STANDARD SIZES FOR O RING GASKETS

Dash	w	I.D.	0.D.	w	I.D.	Dash	w	I.D.	0.D.	w	I.D.
No.	(Nom)	(Nom)	(Nom)	±.004	(Actual)	No.	(Nom)	(Nom)	(Nom)	$\pm .004$	(Actual)
1	1	19	17	.139	$1.609 \pm .010$	27	à	41	51	.139	4.859 ± .015
2	à	19	2	.139	$1.734 \pm .010$	28	à	5	51	.139	4.984 + 015
3	à	17	21	.139	$1.859 \pm .010$	29	à	51	58	.139	5.10° £.023
4	à	2	21	.139	$1.984 \pm .010$	30	1	54	51	.139	$5.234 \pm .023$
5	à	21	21	.139	$2.109 \pm .010$	31	3.	58	58	.139	$5.359 \pm .023$
6	à	21	21	.139	$2.234 \pm .010$	32	i	51	59	.139	$5.484 \pm .023$
7	à	28	29	.139	$2.359 \pm .010$	33	1	58	57	.139	$5.609 \pm .023$
8	à	21	23	.139	$2.484 \pm .010$	34	à	53	6	.139	$5.734 \pm .023$
9	à	28	27	.139	$2.609 \pm .010$	35	1	54	61	.139	$5.859 \pm .023$
10	à	29	3	.139	$2.734 \pm .015$	36	à	6	61	.139	$5.984 \pm .023$
11	à	23 23	31	.139	$2.859 \pm .015$	37	1	61	61	.139	6.234 ± .623
12	à	3	31	.139	$2.984 \pm .015$	38	1	61	63	.139	6.484 ± .023
13	à	31	38	.139	$3.109 \pm .015$	39	1	63	7	.139	$6.734 \pm .023$
14	à	31	31	.139	$3.234 \pm .015$	40	1	7	74	.139	$6.984 \pm .023$
15	i	38	38	.139	$3.359 \pm .015$	41	i	71	71 71	.139	$7.234 \pm .030$
16	à	31	39	.139	$3.484 \pm .015$	42	i	75	79	.139	$7.484 \pm .030$
17	à	38	37	.139	$3.609 \pm .015$	43	1	72	8	.139	$7.734 \pm .030$
18	À	39	4	.139	$3.734 \pm .015$	44	8	8	81	.139	$7.984 \pm .030$
19	à	34	44	.139	$3.859 \pm .015$	45	8	81	81	.139	$8.234 \pm .030$
20	1	4	41	.139	3.984 ± .015	46	1	81	83	.139	$8.484 \pm .030$
21	3	41	42	.139	4.109±.015	47	1	83	9	.139	$8.734 \pm .030$
22	1	41	43	.139	$4.234 \pm .015$	48	1	9	91	.139	8.984±.030
23	1	48	49	.139	$4.359 \pm .015$		8		-		
24	i i	41	42	.139	$4.484 \pm .015$	49	8	91	91	.139	$9.234 \pm .030$
25	1	-	-			50	8	91	92	.139	$9.484 \pm .030$
26	1	49	47	.139	$4.609 \pm .015$	51	8	92	10	.139	$9.734 \pm .030$
20	8	43	5	.139	$4.734 \pm .015$	52	8	10	101	.139	$9.984 \pm .030$

NOTES: Do not use dash numbers over 26 for pressures over 1000 psi. For pressures over 1000 psi use O-ring packings, previous table. See table on opposite page for information on loather tack-up washers used with O-ring gaskets. Dash numbers correspond with AN-6230.

#### STANDARD SIZES FOR LEATHER BACK-UP WASHERS FOR O RING PACKINGS

Ed	iges to be cut o	lean and square	Sect		Dash* No.	O.D. ±1/64	I.D. (Nom.)	+.010 005	±.01
man		10			41	31	31	.188	.094
	-00 -	10	-11/	-1 *	42	39	31	.188	.094
					43	33	31	.188	.094
Dash*	O.D.	I.D.	W	T†	44	37	34	.188	.094
No.	$\pm .007$	(Nom.)	$\pm .007$	±.010	45	4	39	.188	.094
1	.250	1	.057	.062	46	41	33	.188	.094
2	.281	352	.057	.062	47	41	37	.188	.094
3	.312	32	.057	.062	48	48	4	.188	.094
4	.344	18 33	.057	.062	49	41	41	.188	.094
5	.375	32	.057	.062	50	49	41	.188	.094
6	.438	r <sup>fe</sup>	.057	.062	51	49	42	.188	.094
			.057	.062				.188	.094
7	.500	-	.007		52	43	4 5	.240	.12
8	.562	2	.090	.062	53	51	49		
9	.625 .688	78	.090	.062	54 55	51 58	47	.240 .240	.12
10		à					-		
11	.750	18	.090	.062	56	54	5	.240	.125
12	.812	9	.090	.062	57	59	51	.240	.12
13	.875	11	.090	.062	58	53	51	.240	.12
14	.938	3	.090	.062	59	53	58	.240	.12
Dash*	O.D.	I.D.	w	T+	60	6	51	.240	.12
No.	±1/64	(Nom.)	+.010	$\pm .010$	61	61	52	.240	.125
			005		62	61	53	.240	.125
15	1	3	.123	.062	63	62	54	.240	.125
16	118	18	.123	.062	64	61	6	.240	.125
17	13	7 4	.123	.062	65	63	61	.240	.125
18	1 %	18	.123	.062		7		.240	.125
19		1 18	.123	.062	66		61		
20	11		.123	.062	67	71	63	.240	.128
20	1 18	116			68	71	7	.240	.125
21	18	11	.123	.062	69	79	71	.240	.128
22	1,78	1,3	.123	.062	70	8	73	.240	.128
23	13	11	.123	.062	71	81	72	.240	.125
24	1 10	1 16	.123	.062	72	81	8	.240	.125
25	18	13	.123	.062	73	9	81	.240	.128
		_			74	91	9	.240	.125
26	1 111	178	.123	.062	75	10	91	.240	.125
27	13	13	.123	.062	10	10	_		
28	1%	11	.188	.094	76	103	10	.240	.125
29	2	18	.188	.094	77	- 11	101	.240	.128
30	21	13	.188	.094	78	113	11	.240	.125
31	21	12	.188	.094	79	12	113	.240	.125
32	28	2	.188	.094	80	121	12	.240	.125
33	28	21	.188	.094		13	124	.240	.125
34	28	21	.188		81			.240	.125
		24		.094	82	131	13		.128
35	23	29	.188	.094	83	14	13½ 14	.240 .240	.125
36	27	21	.188	.094	84	141			.120
37	3	28	.188	.094	85	15	141	.240	.120
38	31	23	.188	.094	86	151	15	.240	.125
39	31	23	.188	.094	87	16	151	.240	.125
	38	3	.188	.094	88	5	41	.240	.125

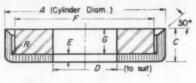
\* Dash numbers correspond with AN 6246. † Thickness T shall not vary more than 0.010-in, between any two points on a ring.

#### STANDARD SIZES FOR LEATHER BACK-UP WASHERS FOR O RING GASKETS

Dash No.*	O.D. ±1/64	I.D. Nom.	W+.010 —.005	T+ ±.010	Dash No.*	O.D. ±1/64	I.D. Nom.	W+.010 005	T† ±.010	Dash No.*	0.D. ±1/64	I.D. Nom.	W+.010 005	T† ±.010
1	13	.15	à	18	19	41	37	à	78	36	61	6	à	16
2	2	13	à	10	20	41	4	h	1,2 1,2	37	61	61	à	10
3	21	17	1	10					4.0	38	69	61	à	16
4	21	2	1	18	21	48	41	1	18	39	7	69	1	
5	28	21	1	1	22	41	41	à	18	40	71	7	1	18
U			8	3.9	23	45	48	à	10	10		•		10
6	21	21	1	18	24	43	41	1	2	41	71	71	à	10
7	28	28	à	10	25	47	48	1	1,2 1,2	42	79	75	à	19
8	23	21	à	16	20	*8	18	8	16	43	8	79	à	18
9	21	28	1		26	5	49	1	18	44	81	8	1	-
10	3	29	3	1,2	27	51	43	1	10	45	81	81	1	10
					28	51	5	1	16	40	og	04	8	3,0
11	31	24	8	18	29	58	51	1	10	46	87	81	2	1
12	31	3	à	18	30			8	18	47	9	89	1	16
13	31	31	à	10	30	51	51	8	3.8	48	91	9	8	18
14	31	31	1	18	31	59	58	1	1		94		8.	16
15	38	38	1	18	32		5 g	8	18	49	91	91		18
4.0						52	51	8	18	50	94	91	8	10
16	34	31	8	18	33	51	59		18		10	0.2		1
17	31	38	À	3,9	34	6	53		18	51	10	93	8	18
18	4	34	1	Y'a	35	61	54	à	18	52	101	10	à	16

Dash numbers correspond with AN-6244.
 † Thickness shall not vary more than 0.010 between any two points on a ring.

#### STANDARD SIZES FOR LEATHER CUP PACKINGS



	<b>J</b>		0 -	(to suit)			28 29 30	31 38 31	200 000	ชร์ ชร์ หรัช	2 1 8 2 1 8 3 16	15 15 15 15	25 25 25 25 25
Dauh No.	A	c	E	F	<b>G</b> .	R	31 32 33	35 37 37	9 9	ชนิ ชนิ ชนิ ชนิ ชนิ	318 318 318 318 318	100 100 100 100 100 100 100 100 100 100	18 18
1 2 3	18	1 1	2/4	32	Th Th	1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1	34 35	444	9	32 32	318	33 35	18
3	10g	37	ala ala ala	10 10 10 10 10 10 10 10 10 10 10 10 10 1	13a 13a 13a 13a	832 832 833	36 37	41	9	33	4 16	35 35	10
5	11	22	23	178		8 व	38 39	5	3	53 53 16 16 16	43	1,6	ie ie ie
6	33	18	क्षेप्र अ	200	373 373 373	272	40	51	27 24	18	5	18 18 18	16
6 7 8 9	18	9	5) 5) 5) 5)	8 15 15 15 15 15 15 15 15 15 15 15 15 15	83 ·	27. 27. 27. 27.	41 42	53 6	24 23	18r	5½ 5½	18	8
10	1 10	à	8		8	2,2	43 44	61	3	18 18 18 18 18	53 6	18 18 18 18	i
11 12	1à 1à	3	1	39 39	9	3/2	45	61 61	24	18 18	61	18	1 1
13 14	18	3	ň	$1\frac{1}{37}$ $1\frac{1}{32}$	8	क्षेत्र स्रोत स्रोत	46 47	7 71	2	Age 3	6½ 6¾	18	1
15	18	à	à	1 87	B	22	48	73	24 24 24	18 18 18 18 18	7	18 18 18 18	8
16 17	13 13	à	à	133 133	2	3/2	49 50	73 8	1	1,9. 1,9.	7± 7±	18	8
18 19	2 21	9	à	183	9	82 83 83 83 83 83	51 52	81	1	18	8	18	1
20	21	ă	à	133	8	22	53	91	1	18 18 18 18	81	18	1
21 22	2 g 2 h	3	ħ.	21	2	83 83 83	54 55	10 101	111	18	9½ 10	13 13 13 13 13	1
23	28	à	1	2 3 2 2 3 2 2 1 3 2 1 3 2 1 3	200	23	56	11	11	Ag	101	11	1
24 25	27	b b	h	211 211	3	त्रोत स्रोत	57 58	11½ 12	11 11	18 18	11 11)	118	1

NOTE: The above are standard commercial sizes recommended for new designs. Other sizes for equipment already in use are available.

Dash No.\*

31

32

A

35

34

34

C

E

Dt

24 24

10

3.267

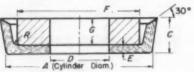
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 $\mathbf{R}$ 

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#### STANDARD SIZES FOR FABRICATED CUP PACKINGS

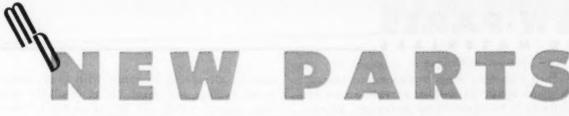


		L	- A (Cyli	nder Diam	)	1		34 35	4 44	98	204.034	10 m	3.643 3.891	10	
,	Dash No.*	A	0	D	Е	F	R	36 37	43	8	1	2/2 2/3 2/3	$\frac{4.155}{4.393}$	19	
	10 11 12 13 14 15	1 1h 11 11 11 15 12	4	20 CB CB -51 -51 -51 -51		.708 .835 .961 1.085 1.203 1.332 1.459	838 839 839 839 839 839	38 39 40 41 42 43 44	5 51 51 52 6 61 61	ত্ৰক তাক তাক তাক তাক ভাক ভাক	15 15 15 15 15 15 2	18 18 18 18 18 18 18	4.579 4.842 5.074 5.332 5.579 5.826 6.073	To To The Part of	
	17 18 19 20 21 22	13 2 24 24 21 21 23 25				1.584 1.709 1.832 1.959 2.082 2.203 2.334	100 100 100 100 100 100 100 100 100 100	45 46 47 48 49 50 51	67 71 71 71 72 8	1	2 2 2 2 2 2 3 3 3 3 3	16 16 16 16 16	6.325 6.585 6.821 7.084 7.331 7.467 7.959	760 750 750 750 750 750 750 750 750 750 75	
	24 25 26 27 28 29 30	23 25 3 3 3 3 3 3 3 3			***	2.448 2.585 2.641 2.752 2.897 3.022 3.140	822 823 823 823 823 823 824	52 53 54 55 56 57 58	9 9 10 10 10 11 11 11 12	1 1 1 1 1 1 1 1 1 1	4 4 5 5 5 5 5		8.459 8.953 9.445 9.943 10.441 10.941 11.440	- 12 - 12 - 12 - 12 - 12 - 12 - 12 - 12	

\* The above are standard commercial sizes recommended for new designs. Other sizes for equipment already in use are available. For sizes smaller than dash 10, refer to previous table, showing leather cup standards.

† Hole size specified is minimum only and can be furnished larger. R is radius of packing and inside follower plate. All cups will have flared walls so that lip diameter will actually be oversize to cylinder bore.

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#### AND MATERIALS

For additional information on these new developments see Page 173

#### Interrupted-Rotation Drive



Constant speed input is converted and reduced by Augur Movement power transmission to produce quick reversing action that interrupts rotation of output shaft every 45 degrees of travel. This action is short back-up motion that occurs approximately eight times in one complete revolution of output shaft. Transmission is smooth and continuous, and reversing action does not develop torque

counter to direction of rotation.

Originally designed as machine tool accessory to perform honing and lapping operations, unit is adaptable as either power transmission or agitator. It is recommended as power transmission for tumbling barrels, screw feed stokers, cement mixers, washing machine agitators, rotating displays, deep well drills, and similar equipment. It can be used for agitation in plating solutions; mixing paints, varnish and other chemical compounds; and in shakeout screens and hopper feeds. Other applications include buffing and polishing, pipe threading, valve grinding and floor sanding machines. Three standard sizes are available, and special sizes can be supplied if desired. Manufacturer: Metal Seal & Products Inc., 21855 St. Clair Ave., Euclid 17, O.

For additional information circle MD 1 on Page 173

#### Disk Type Air Control Valve

Pilot controlled and piston operated, model NFS packless footoperated disk-type valve is designed to direct compressed air alternately to two pressure ports for operation of double-



acting air cylinder. Sliding self-lapping main valve disk is shifted by reciprocating light metal piston which is moved by alternately admitting line pressure to one end and venting other. Although constructed to withstand full weight of operator, foot pedal actually operates only small pilot valve and moves less than ¾-in. under slight foot pressure for quick, easy action. Valve is available in ½ and ¾-in. sizes for air pressures from 25 to 150 psi. Safety guard, which extends over pedal and minimizes possibility of unintentional operation, is optional. Manufacturer: Hannifin Corp., 1116 S. Kilbourn Ave., Chicago 24, Ill.

For additional information circle MD 2 on Page 173

#### Lifetime Lubricated Motors



Available in frame sizes 11 and 21, type KSP motors can be used to drive exhaust and cooling fans, evaporative and condensing coolers, unit and space heaters as well as small pumps, agitators and blowers. They can be furnished in open or

totally enclosed construction with ratings from 1/40 to 1/12-hp at 115 or 230 v, 60 cycles, 1050 or 1550 rpm.

Lubrication system provides constant flow of oil from large reservoir to bearing surfaces regardless of position of motor. Oil-saturated packing continuously feeds bearing; no additional lubricant is required. Features include unit-bearing construction in shaft end for greater strength on direct-connected loads, treated stator windings of Formex insulated wire, and vibration absorbing resilient end rings which are resistant to oil and aging. Mounting arrangements include end ring, resilient cradle base and band mounting; motors can be furnished with four tapped holes on shaft end for end mounting. Manufacturer: General Electric Co., Schenectady 5, N. Y.

For additional information circle MD 3 on Page 173

#### **V-Type Packing**

Usable for rams with diameters over 20 in., Vee-Dam fabric-reinforced packing is supplied in  $\frac{5}{8}$ ,  $\frac{3}{4}$ ,  $\frac{7}{8}$  and 1-in. sections. Fully flexible material prevents lateral passage of liquid as well as normal labyrinth flow. Precision square-cut butt joints permit ring to be cut full inch longer than actual circumference on size no larger than 4 ft, and still be installed with



AND MATERIALS

ease. This helps packing ring to expand to breach over-width gland space, as well as provide excess of length not likely to be exceeded by shrinkage. Where shrinkage might cause separation of joints, design will prevent labyrinth flow. Manufacturer: Linear Inc., Philadelphia 35, Pa.

For additional information circle MD 4 on Page 173

#### **High-Temperature Swivel Joint**

Made in eight styles for 360-degree turning in one, two and three planes, this swivel joint with metallic seal will operate at temperatures to 600 F and maximum working pressure of 300 psi. Metallic seal is fully effective in both con-

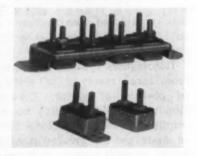


stant and intermittent service. Easy turning takes place on stainless steel balls which help absorb radial and thrust loads. Joint can be installed in any desired sequence and is supplied in  $\frac{3}{4}$ , 1,  $\frac{11}{4}$ ,  $\frac{11}{2}$  and 2-in. sizes with either threaded or flanged ends. Manufacturer: Chiksan Co., Brea, Calif.

For additional information circle MD 5 on Page 173

#### **Automatic Reset Circuit Breakers**

Previously limited to automotive applications, Fasco line of automatic reset circuit breakers has been expanded to include types for use on aircraft, battery chargers, electroplating circuits and other 6, 12 and 24-v opera-



tions. Available in 8, 10, 15, 20, 25 and 30-amp ratings, they can be supplied singly or in multiples of two, three or four in Snap-Mount brackets. Individual circuit breakers can be furnished with their own mounting straps.

When protected circuit is overloaded, bimetal blade snaps open to open circuit; when blade cools, it snaps back to close circuit. This off-and-on cycle continues until trouble is corrected. Manufacturer: Fasco Industries Inc., 350 North Union St., Rochester 2, N. Y.

For additional information circle MD 6 on Page 173

#### Small Variable-Speed Transmission

Suitable for use in instruments, recorders, timers, office machinery, light conveyors and similar equipment, model 10 small size variable speed transmission

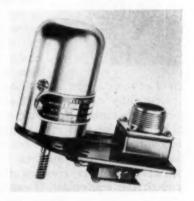
delivers all speeds in range with great accuracy of speed holding and reset. It is available with lever type control which can be connected to mechanical hydraulic, electric and pneumatic automatic control devices or can be furnished with micrometer control for extremely fine adjustment.

When driven at 2700 rpm, transmission delivers speeds from 1800 to 0 rpm; and at 1800 rpm input, it gives speeds from 1200 to 0 rpm with torque of 50 oz-in. Built-in reduction gearboxes with ratios from 5:1 to 1000:1 are available for use with drive to deliver torque up to 250 lb-in. Transmission is self-lubricated and has sealed bearings which permit mounting in any position. Manufacturer: Graham Transmissions Inc., 3754 N. Holton St., Milwaukee 12, Wig

For additional information circle MD 7 on Page 173

#### Miniature D-C Motor

Designed to keep weight and size to a minimum, model 1305 1/100-hp d-c motor can be used for any type of application requiring linear or rotary motion. Running torque is listed at 1 oz-in. at 10,000 rpm on 28 volts d-c, but motor is adaptable to other torque ard speed require-

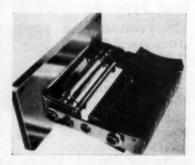


ments and to specific plans and housings. Brush and brush holder are compact in size and motor weighs 15 oz. Dimensions, excluding worm gear, are 2.875 x 1.75 in. and mounting plate measures 2.7 x 3.4 in. Manufacturer: Electro-Aire Inc., 11439 Vanowen St., N. Hollywood, Calif.

For additional information circle MD 8 on Page 173

#### **Journal Box Lubricator**

Available in models for practically all styles of journal boxes, this lubricator is designed for journals on overhead cranes and similar industrial equipment. It consists of special nonglazing felt wicks attached to holder which holds



wicks in place with correct pressure against axle to provide full and constant lubrication to bearings and thrust flanges at all times. Complete assembly fits into journal box and can be installed in three simple steps. Only service required is periodic check-

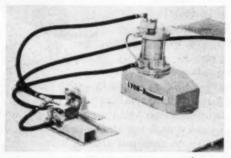


ing and filling of oil reservoir. Felt wicks have long life and are easily replaced with sets matched at factory, impregnated with high quality oil and sealed in oilproof container. Manufacturer: Miller-Felpax Corp., Dept. I., Winona, Minn.

For additional information circle MD 9 on Page 173

#### Air-Actuated Hydraulic Pump

Capable of pumping oil at 1 to 1½-gpm rate, this continuous-acting pump develops a working oil pressure of 1000 psi from 90-psi air pressure. Units with higher working pressures are available also. Reciprocating valve alternately diverts air pressure from one side of air piston to other. Small hydraulic piston directly connected to air piston pumps oil under high



pressure. Pump is equipped with built-in-release valve to permit pressurized oil in hydraulic cylinder to return to reservoir by gravity. Single three-position four-way foot valve operates release and controls pumping action. Pump is designed for use with hydraulic elevating tables, positioners and strip and sheet feeding tables. Manufacturer: LYON-Raymond Corp., 7259 Madison St., Greene, N. Y.

For additional information circle MD 10 on Page 173

#### Pillow Block

Designed especially to handle heavy loads over long periods of service, these normal and heavy-duty spherical roller bearing pillow blocks are supplied in bore sizes ranging from 2-7/16 to approximately 8 in. Built for either straight shaft or adapter type mounting, they are self-aligning and incorporate either felt or triple metallic labyrinth seals. Manufacturer: Fafnir Bearing Co., New Britain, Conn.

. For additional information circle MD 11 on Page 173

#### Resistor Coil

Possibility of porcelain breakage is minimized in Expand-ohm Edge-wound resistor by core expansion feature and stiffening ribs on core bar which confine flexing to points where porcelain is relieved. Among applications of unit are controlling speed or reducing starting voltages for a-c and d-c motors. Units can be grouped in parallel to handle increasing currents.

They are available in capacities ranging from 11 to 85 amps in small increments and will carry rated current continuously without exceeding 375 C temperature rise. Standard mounting frame is mill type construction which can be enclosed readily by perforated metal screen when required. Both clamp and brazed type terminals are available. Manufacturer: Euclid Electric & Mfg. Co., Madison, O.

For additional information circle MD 12 on Page 173

#### Postive-Operating Bimetal Thermostat

Positive-operating bimental type R low-voltage circuit control thermostat is designed for use in appliances and for industrial and electronic applications requiring precise temperature control. It is available in manually adjustable or preset nonadjustable types. Both can be obtained with wide variety of terminal arrangements and in many operating ranges

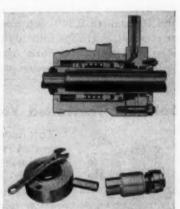


up to 600 F. Containing electrically independent bimetal strip that eliminates artificial cycling, thermostat responds only to temperature changes in controlled device or surrounding air. Manufacturer: Stevens Mfg. Co., Mansfield, O.

For additional information circle MD 13 on Page 173

#### **High-Pressure Mechanical Seals**

These mechanical seals can effectively replace conventional packing in refining, process and chemical industry pumps and in pipe line installations. They are easily installed and require no adjustment during or after installation. Type U balanced high-pressure single seal is intended for use on shafts of from



 $1\frac{1}{8}$  to  $5\frac{\pi}{8}$ -in. diameter and can be adapted to larger shafts if necessary. When constructed of corrosion and heat-resistant materials, this type is suitable for service where high temperatures and corrosive liquids are handled at high pressures.

Simple and inexpensive, type L low-pressure single seal is designed for small pumps handling cold water or bulk station products where temperatures do not exceed 110 F and pressures do not go above 50 psi. It is suitable for pumps where shaft diameters do not exceed 2 in.

Type B oil-lubricated double seal is intended for

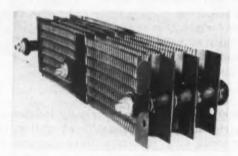


high pressures and cold service where pumped liquids have little lubricating value. Applications include high pressure pipe lines where products such as butane and propane are pumped. Two-compartment oil tank assembly included with seal supplies oil to compensate for lubrication leakage. Manufacturer: Byron Jackson Co., Pump Div., Terminal Annex Box 2017, Los Angeles 54, Calif.

For additional information circle MD 14 on Page 173

#### **High-Current Power Type Resistor**

Recommended for industrial, marine and transportation applications, this Multipath high-current power type resistor utilizes element made of slit and formed alloy sheet. This construction increases sur-



face area and heat dissipation; and since mesh is made of same material as support, there is no mechanical or electrical break. Resistance of supporting element is low, and heat developed in it is only onefifth to one-ninth that generated in mesh. Units of this type can be obtained with ratings from 4.35 ohms and 22 amp to 0.340-ohm and 80 amp for use singly or stacked in groups four high. Manufacturer: Exmet Electrical Corp., 59 Park Ave., New York 16, N. Y.

For additional information circle MD 15 on Page 173

#### Solenoid-Controlled Valve



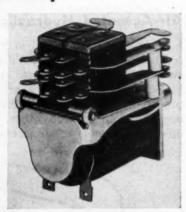
This model 1044 four-way pilot operated valve can be operated continuously at any cycling speed up to 600 cycles per minute. It is available in two types, one for operation on line pressures from 0 to 50 psi, the other for 30 to 150 psi. Two main valve members are disposed in vertical alignment with two parallel bores in valve body and move up and down simultane-

ously to open and close their respective inlet and exhaust ports. When one valve is open to inlet and closed to exhaust, other is closed to inlet and open to exhaust. With solenoid de-energized, valve members are held up by combination of light stainless steel springs and fluid pressure; when solenoid is energized to actuate integral three-way pilot valve, they are moved down by pressure applied to pistons. Cast bronze bodies have screwed pipe connections tapped for 1/4, 3/8, 1/2 or 3/4-in. I.P.S. Manufacturer: Crescent Valve Co., 5073 State St., Huntington Park, Calif.

For additional information circle MD 16 on Page 173

#### **Miniature Control Relay**

This type TKL miniature relay is available in contact combinations up to fourpole double-throw with either silver or palladium contacts. Contacts are rated 1 amp at 115 volts, a-c or 1 amp at 32-volts. d-c noninductive. Coils can be supplied for any operating voltage up to 115 volts, d-c. Relay



measures 1-19/32 x 61/64-in. with height, varying according to contact combinations, normally 1-17/32in. Coil is of cellulose acetate sealed construction that gives relay maximum resistance to humidity and moisture. Unit can be obtained also in hermetically sealed enclosures. Manufacturer: American Relay & Controls Inc., Chicago 44, Ill.

For additional information circle MD 17 on Page 173

#### **Totally-Enclosed Single-Phase Motor**

Incorporating Reverswitch motor reversing switch, this single-phase 1/3-hp motor starts in either direction, reverses instantly and can be allowed to stop normally or stopped immediately at flip of built-



in control switch. It features shielded ball bearings, automatic overload protection, totally enclosed design and resilient mounting. This capacitor-start model has NEMA No. 56 frame size, operates on 115 v and has 1725-rpm full load speed. Suitable applications include use of lathes, hoists, conveyors, overhead doors, displays, washing machines, grinders, power rollers, testing machines and automatic machinery. Manufacturer: Heating Control Div., Iron Fireman Mfg. Co., Portland, Oreg.

For additional information circle MD 18 on Page 173

#### Oil-Resistant Air Hose

Three-ply fabric reinforced type 22 air hose is improved by use of oilproof rubber compounds throughout. Hose can be used for variety of applications in



addition to its primary use as air hose, including handling of petroleum solvents and lubricating oils. Smooth red finish cover resists weathering and sun checking, and tube will not flake off to plug attachments or tools. Strong adhesion of cover to carcass enables hose to withstand repeated bending and flexing with little danger of separation. Hose is supplied in 1/4, 5/16 and 3/8-in. sizes. Outside diameters are 1/2, 9/16 and 21/32-in., respectively, and weight per 100 ft is 10.3, 12.2 and 15.1 lb. The two smaller sizes withstand 150 psi working pressure and the larger withstands 125 psi. Manufacturer: B. F. Goodrich Co., Akron, O.

For additional information circle MD 19 on Page 173

#### Lightweight Gasoline Engine



Having 2-in. bore and  $2\frac{1}{2}$ -in. stroke, Servi-Cycle single cylinder two-eycle gasoline engine develops  $3\frac{1}{2}$  hp at 3800 rpm and has maximum torque of 61 lb-in. at 2500 rpm. Through use of aluminum die-cast crankcase, connecting rod and cylinder with cast-in cast iron sleeve, engine weight, less magneto, is only 12.7 lb. Piston is permanent-mold aluminum alloy, having two compression rings. Forged

steel balanced crankshaft is supported by two large tapered roller bearings. Fuel is admitted through die-cast rotary valve from Tillotson type MT carburetor. Manufacturer: Simplex Mfg. Corp., New Orleans 19, La.

For additional information circle MD 20 on Page 173

#### Fractional-Horsepower V-Belt

This fractional horsepower V-belt is designed for exacting conditions in air moving field such as in attic fans, furnace fans and air conditioning units where smooth vibrationless performance is necessary. Available in wide range of sizes, it has uniform cross-section and is noiseless. Manufacturer: Browning Mfg. Co., Maysville, Ky.

For additional information circle MD 21 on Page 173

#### Synthetic Rubber Compound

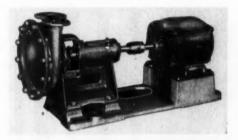
Molded, extruded and die-cut rubber parts fabricated from Stallite 863 rubber compound will withstand action of wide range of reagents, acids, alkalies and heat. Material has high flex and abrasion resistance, and its dielectric properties make it suitable for many applications in electrical equipment. Parts fabricated from compound can have durometer hardness ranging from 40 to 80, tensile strength up to 2000 psi and elongation up to 500 per cent. Applications include seals, stoppers, gaskets, washers, tub-

ing, rubber stamp blanks and other parts that come into contact with chemicals or corrosive atmospheres. Manufacturer: Stalwart Rubber Co., 180 Northfield Rd., Bedford, O.

For additional information circle MD 22 on Page 173

#### Stainless Steel Pumps

Designed for handling corrosive liquids in process and other industries, Fig. 3705 stainless steel centrifugal pumps are built in eight sizes with capacities up to 750 gpm and heads up to 180 ft. Semiopen type



impeller is statically and hydraulically balanced. Pump is regularly supplied in No. 316 or FA 20 stainless steel, but can be furnished in other metals or alloys to suit conditions of service. Manufacturer: Goulds Pumps Inc., Seneca Falls, N. Y.

For additional information circle MD 23 on Page 173

#### **Variable-Speed Motor**

Recommended for agitator drives and for building into machines, Speed-Trol vertical face-mounted motor is equipped with easy-to-read speed indicator. Use of indicator facilitates infinite speed adjustment either through fingertip control on motor or through mechanical, electrical or lever type controls. Motor is Klosd-Tite



type built integrally with pulleys, shafts and belts. Unit can be obtained also with flange mounted construction. Manufacturer: Sterling Electric Motors Inc., 5401 Anaheim—Telegraph Rd., Los Angeles 22, Calif.

For additional information circle MD 24 on Page 173

#### Flywheel Loom Motor

Totally-enclosed, integrally-mounted flywheel of this line of electric loom motors minimizes variations in speed and current, thus reducing power consumption and allowing increased loom speed without increasing horsepower. Furnished in ratings from 34 to 2 hp, 1800 to 1200 rpm, motors are of totally-enclosed con-

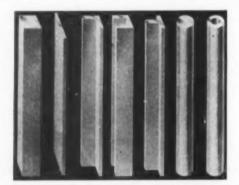


struction. Integrally-cast rotor fan distributes motor heat evenly, and oil fittings are conveniently located to facilitate lubrication. Manufacturer: General Electric Co., Schenectady 5, N. Y.

For additional information circle MD 25 on Page 173

#### Iron Castings

Cast of Meehanite, standard shapes and forms are 12 in. long and can be obtained in sizes from \(^1\)/4 to 12 in. for squares and flats; \(^1\)/4 to 18 in. for rounds and bushings; and 1 to 18 in. for angles, channels and



tees, with  $\frac{1}{8}$ -in. allowance on all dimensions for finishing. Castings have tensile strengths of between 15 and 25 tons per square inch combined with fast machinability and no porosity. Manufacturer: Motors & Metals Inc., 220-4 W. 42nd St., New York 18, N. Y.

For additional information circle MD 26 on Page 173

#### **Terminal Block**

Made of molded Melamine for high dielectric strength, these sectional terminal blocks can be assembled into strips of any length from one to 75 pairs. Units are twisted into keystone type mounting channel, and intermediate units can be removed without disconnecting other units. End clamps are available in both spring type requiring no drilling and anglebracket type held in position by mounting screws. Terminals can be obtained in 25 and 50-amp sizes for use up to 600 volts ac or dc. Conductors as large as No. 10 solid copper wire can be used with 25-amp blocks and conductors as large as No. 4 stranded cable with 50-amp blocks. Manufacturer: Westinghouse Electric Corp., P. O. Box 868, Pittsburgh 30, Pa.

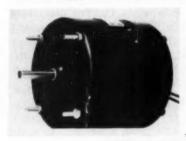
For additional information circle MD 27 on Page 173

#### Free-Machining Steel

Tests indicate that Ledloy leaded open hearth freemachining steel machines from 30 to 50 per cent faster than AISI B1113 steel. Cutting tools used on this material last considerably longer between grindings, and finished product is smoother than on comparable steels, Leaded steel has good strength and ductility, provides good base for plating and will carburize with sound cross section. Manufacturer: Joseph T. Ryerson & Son Inc., P. O. Box 8000-A, Chicago 80, Ill.

For additional information circle MD 28 on Page 173

#### Three-Speed A-C Motor



Manufactured in six, four and two-pole types ranging from 1/40 to 1/8-hp, Tri-Motor three-speed a-c motor incorporates built-in speed control to reduce materials and assembly costs. Unitized construction

with no external choke coil is said to assure quiet operation. Manufacturer: Marco Industries Inc., 1611 Terrace Blvd., Depew, N. Y.

For additional information circle MD 29 on Page 173

#### **Low-Temperature Alloy**

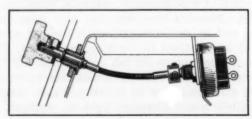
A noneutectic alloy of bismuth and tin, Cerrocast has reasonable hardness, negligible shrinkage and extensive melting range. It is especially suitable for use in precision casting where, because of its long melting range, it can be coined readily to reproduce accurately the shape, dimensions and fine surface details of master pattern. It can be used also in spray guns and for low-temperature soldering of pretinned metal parts. Melting range is 281 to 338 F; yield temperature, 302 F; weight, 0.296-lb per cu in.; Brinell hardness, 22; and shrinkage, 0.0001- in. per in. Manufacturer: Cerro de Pasco Copper Corp., New York City, N. Y.

For additional information circle MD 30 on Page 173

#### Flexible Shaft Coupling

Of light-duty type, series of flexible shaft couplings permits remote control of equipment, being particularly adaptable to use in electronics and instrumentation fields. They can be used for knob controls of tuners, band switches, small valves, gears and pulleys and as driving medium for light transmission systems where connected shafts are misaligned. Line of standard fittings is available with threaded, socketed, slotted, flatted, splined and plain terminals for wide range of applications. Manufacturer: Elliott Mfg. Co., 217 Prospect Ave., Binghamton, N. Y.

For additional information circle MD 31 on Page 173



#### SLEEVE BEARING DATA



#### SLEEVE BEARING DATA

### Stock Sizes or Specials?

HE trend, in recent years, among leading designers of machinery and equipment is to use standard stock parts rather than specials wherever possible. And there is sound reasoning behind this move. particularly in cast bronze sleeve bearings.

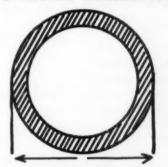
Naturally in some instances it is essential to design and produce a special bearing for a specific application. Such factors as flanges, wall thickness, taper, special alloys and other characteristics that cannot be provided for in stock bearings can only be secured through special manufacturing operations. This often necessitates special patterns, tools, dies or other equipment not included in the cost of stock items. With the exception of long production runs of one size, special bearings are more costly than stock items.

The factors that favor the designer in working to standard stock bearings are many. First, he has an unusually large range of sizes from which to make his choice. At the present we list over 850, comprised of 55 inside diameters, ranging from  $\frac{1}{4}$  inch to  $4\frac{1}{4}$ ; 55 outside diameters  $\frac{3}{8}$  to  $4\frac{1}{2}$ ; 46 lengths ranging from  $\frac{3}{4}$  to  $9\frac{3}{4}$ . Thus it is possible to secure practically any size combination desired.

Standard stock bearings are cast in what is usually referred to as a general purpose alloy, providing better than average physical prop-



55 Inside Diameters



55 Outside Diameters



46 Lengths

#### altered where closer precision is required or where greater clearance is necessary. Stock bearings are lower in cost, too,

erties assuring long life and excel-

lent performance. Oil grooves, slots, or holes are easily, quickly and eco-nomically added. Standard toler-

ances, as listed below, can easily be

a very important feature in today's market. By making long runs of each size we are able to secure a low unit cost, which saving is passed on to the user. There is never any charge for patterns or tools. Complete stocks of all sizes are always maintained providing immediate delivery in any quantity. This eliminates the necessity for maintaining extensive inventory yet provides immediate service.

#### **Engineering Service**

It has always been the policy of the Johnson Bronze Company to work with customers in order to give them the greatest value for their money when purchasing bearings. In many cases we have found that a very slight change in bearing specifications or a slight alteration of a stock bearing will give the user the full benefits of this stock bearing service. We can also help you determine the correct type of bearing for each application. As we manufacture all types of Sleeve Bearings, we base all of our recommendations on facts, free from prejudice. Why not take full advantage of this free service?

#### **Tolerances**

Years of constant study of the bearing requirements of machinery builders have not only guided the selection of the sizes to stock as standard but have also governed the decision on the proper tolerances to standardize on. We find the following most acceptable:

Outside Diam. up to 3"....plus .002" to .003" Outside Diam, above 3"...plus .003" to .005"

All Inside Diameters . . . . . . plus or minus .001" All Lengths......plus or minus .005" This bearing data sheet is but one of a series You can get the complete set by writing to-



SLEEVE BEARING HEADQUARTERS 525 S. MILL ST. . NEW CASTLE, PENNA.



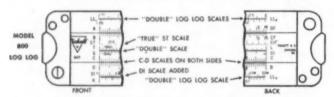
CATALOGUE —Lists and describes the most complete stock bronze sleeve bearing service on the market. Its more than 80 pages are filled with helpful bearing data. Write for free copy.

# ENGINEERING DEPARTMENT

#### For additional information on this new equipment see Page 173

#### Log Log Slide Rule

Utilizing double scales, the 10-in. model 800 log log slide rule places six log log mated scales together with numbers and their reciprocals back-to-back for accurate, easy reading. C scales are placed on both sides and DI scale is included. True ST scale gives average



of S and T scales for angles up to 5.73 degrees. All scales are decimally divided, co-ordinate front and back, are full unit length and refer to C and D scales. Having distortion-free magnesium alloy body, rule measures  $12\frac{1}{8} \times 1\frac{1}{2} \times 5/32$ -in. Manufacturer: Pickett & Eckel Inc. 1111 S. Fremont Ave., Alhambra, Calif.

For additional information circle MD 32 on Page 173

#### Cathode-Ray Oscillograph



Recurrent and driven sweeps variable from 2 to 30,-000 cycles per second are indicated by types 304 and 304-H cathoderay oscillographs which supersede models for type 208-B. Extremely slow sweeps of 10 seconds or more are obtained by connection of excapacitors ternal between X-input

terminals on front panel. Stable high-gain a-c and d-c amplifiers are provided for both X and Y axes. Circuit design assures instantaneous recovery from signal overload even at high gain. Vertical deflections on these instruments can be expanded to four times full-screen diameter; horizontal deflections, to five times full-screen diameter. Positioning controls have sufficient range that any portion of fully expanded pattern can be centered on screen, with no on-screen distortion present. Stabilized synchronization of pattern is maintained by sync-limiting circuit,

so sweep length and synchronization are unaffected by variations in signal voltage level.

In type 304, the cathode-ray tube is operated at overall accelerating potential of 1780 v. In type 304-H, additional intensifier power supply increases this potential to 3000 v. Higher accelerating potential of latter type facilitates use of long-persistence screens so that fullest possible advantage can be taken of slow recurrent sweeps, high-speed driven sweeps, and d-c amplifiers of instrument. Writing rates as high as 2.8 in. per microsecond can be photographed from screen of type 304-H using Du Mont camera. Manufacturer: Allen B. Du Mont Laboratories Inc., Instrument Div., 1000 Main Ave., Clifton, N. J.

For additional information circle MD 33 on Page 173

#### **Photocopy Machine**

Copies of anything written, printed, drawn, typed or photographed in reduced or enlarged size at rate of three 18 x 24-in. photocopies per minute can be made with Foto-Flow model C semiautomatic photocopying machine. No darkroom is required as paper rolls can be changed in daylight without danger of exposure. Timing and print transport are automatic; operator merely sets clock for required exposure



time. Electrical relay makes exposure while mechanical counter records number of copies made.

Automatic conveyor feeds prints through developing tank into hypo tray, making possible controlled 45-second developing cycle. Machine accepts materials up to 36 x 48 in. which can be reduced in one exposure to 18 x 24 in. Copy 9 x 12 in. in size can be enlarged to 18 x 24 in. in one exposure. Machine

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NOW...get Lok-Thred's
greater strength . . more positive
locking action . . in any size
stud, bolt or screw

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#### SEE THE DIFFERENCE!

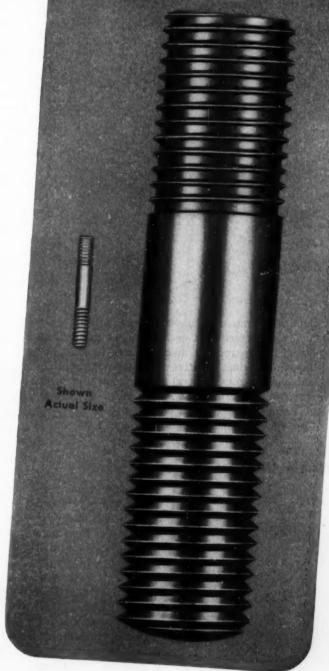
LOK - THRED

FORM

AMERICAN NATIONAL
THREAD FORM

Note Lok-Thred's larger cross section . . . and flat root surface instead of a relatively sharp "V" . . . as compared to the American National Thread form. Here's the secret of Lok-Thred's greater strength.







National

Pacific Coast: National Screw & Mfg. Co. of Cal. 3423 So. Garfield Ave., Los Angeles 22, Cal.

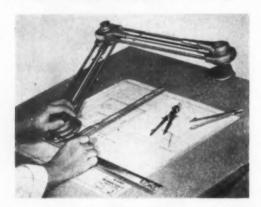
### EQUIPMENT

is of all-metal construction with all parts which contact chemicals of stainless steel, nickel castings and corrosion-resistant materials. Manufacturer: Haloid Co., Haloid St., Rochester 3, N. Y.

For additional information circle MD 34 on Page 173

#### **Drafting Machine**

Sturdy spring counterpoise attached to support bracket of 'this Vemco Versatilt drafting machine permits it to function on drawing board tilted from 0 to 20 degrees. Indexing mechanism for setting 15-degree positions includes large thumb piece formed to afford secure grip from tip to root. Simple vertical



movement of thumb release disengages indexing mechanism for convenience in setting angles other than multiples of 15 degrees. Other features include full circle baseline setting, positive band tightening, steel arms and band covers, central skid button and large protractor. Manufacturer: V. & E. Mfg. Co., P. O. Box 950, Pasadena 20, Calif.

For additional information circle MD 35 on Page 173

#### Portable Ultrasonic Tester



Steel billets, forgings, castings, finished stock, welds and wide variety of machined parts can be tested for defects by anglebeam technique with improved type UR style 50E351 Reflectoscope portable ultrasonic instrument. Unit transmits pulsed ultrasonic vibrations into material under test, at right angles

to surface, by means of crystal transducer or searching unit. When vibrations are intercepted by defect or reach other side of material, they are reflected back to searching unit. Resulting indications on cathode-ray tube indicate start of pulse and reflected

vibrations. Their position on horizontal axis accurately locates position of defect in material in relation to surface.

Modifications to facilitate interpretation of test results include improved pattern of square-wave inch markers on horizontal axis of screen. Reject control gives operator additional control of sensitivity by rejecting indications of small defects which do not affect performance of part or material under test. Removeable cover contains space for carrying all searching units and necessary cables. Rectangular bezel frames oscilloscope screen, and molded rubber bumpers protect corners of instrument. Carrying handles and controls are recessed, and removable bracket holds searching unit when not in use. Manufacturer: Sperry Products Inc., Danbury, Conn.

For additional information circle MD 36 on Page 173

#### Whiteprinting Machine

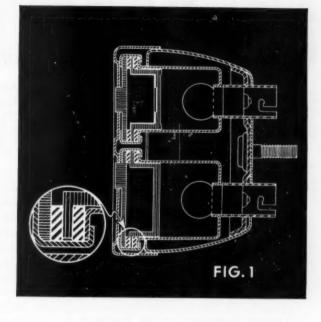
Ammonia vapor white prints are printed and developed continuously on cut sheets or rolls at speeds up to 32 fpm by Pacemaker automatic Whiteprinting machine. It reproduces tracings, drawings, foil, film or anything typed, written or drawn on translucent paper. By means of lever, either sliding-revolving contact or straight revolving contact can be selected to suit type and size of material being reproduced. Interlocking roller developer makes it possible to develop all types of diazo materials with-

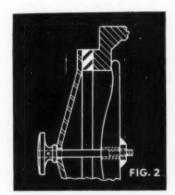


out sticking, scratching or wrinkling and prevents prints from becoming lost in developer or emerging distorted. Exposed prints are automatically conveyed into developer, while tracing or original copy is returned to operator for additional feedings.

Other features include instantaneous and positive speed control, cooling system which maintains constant low temperature across width of glass contact cylinder, and exhaust system that completely expels vapors. Machine operates on 200/250-v, 60-cycle

# Light pressure seals for stamped and rough-cast parts





F1G. 3

Sealing stamped and rough-cast surfaces requires gasket materials with an unusual combination of properties. These materials must be soft enough to seal irregular surfaces without buckling light stampings. Yet they must be sufficiently firm to retain their kickback. And, of course, they must be impervious to the sealed medium.

These diverse requirements are met by Armstrong's Cork-and-Rubber Gasket Materials. Compressible cork particles dispersed throughout a matrix of synthetic rubber give cork-and-rubber its softness and lasting resilience without objectionable sideflow. Cork-and-rubber also has a resistance to fluid penetration that is comparable to straight synthetic rubbers.

In figure 1, for example, cork-and-rubber provides a weathertight seal on a stamped signal lamp housing. It conforms to surface irregularities in both the flanges and lens and cushions the lens against breakage. Re-

silient cork-and-rubber also reseals tightly when broken lenses and burned-out bulbs have been replaced.

Cork-and-rubber provides an effective seal for the stamped diesel hand hole cover in figure 2. Its softness permits economical light pressure assembly without buckling the cover. Yet despite frequent opening and closing of the cover, cork-and-rubber retains its sealing efficiency.

On waterproof electric motors, an unmachined cast flange and stamped cover plate are sealed with cork-and-rubber as shown in figure 3. Cork-and-rubber conforms to surface irregularities and is unaffected by exposure to oils and salt water.

Light pressure seals are but one kind of problem solved by Armstrong's Cork-and-Rubber. Chances are, its unique properties can help seal your problem jobs. We suggest that you contact your Armstrong representative today.

#### Send for this Gasket Handbook

You'll find useful application and specification data in the revised 24-page booklet, "Armstrong's Gasket and Sealing Materials." It contains up-to-date information on straight synthetic rubber, cork-and-synthetic-rubber, and cork composition gasket and sealing materials.

This booklet includes ten technical

discussions of the factors influencing modern gasket and joint design. It also suggests methods of putting Armstrong's stock materials to specialized uses in such fields as radio, electrical, automotive, petroleum, and transportation industries.

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### EQUIPMENT

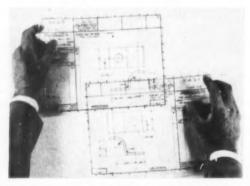
single phase alternating current with starting current of 32 amps and running current of 48 amps. Manufacturer: C. F. Pease Co., Chicago, Ill.

For additional information circle MD 37 on Page 173

#### **Direct-Positive Film**

By means of Kodagraph Autopositive film, positive copies can be produced directly from engineering drawings, maps and surveys. Film can be handled in normal room light and exposed on any copying machine having high-intensity light source. Highly translucent support affords high print-back speed, while high resolving power and contrast of silversensitized emulsion retain fine lines and minute detail. Consequently film is useful for restoring worn, stained or faded drawings without necessity of retracing.

Film can be printed with emulsion side in contact with face of drawing to produce reverse-reading positive which can be viewed easily from back to become,



in effect, right-reading. When copying material printed on opaque stock or on both sides of page, it can be reflexed and right-reading print obtained by reading through back. Since film has matte surface on both sides, additions or corrections can be made in ink or pencil; and deletions can be made with standard two-solution eradicator. Film is available in 30 and 100-ft rolls in widths of 24, 30, 36, 42, and 44 in. Manufacturer: Eastman Kodak Co., Rochester 4, N. Y.

For additional information circle MD 38 on Page 173

#### **Load & Pressure Cells**

Utilizing SR-4 resistance wire strain gages, five models have been added to line of load and pressure cells. In load cells, gages are bonded to compression column so that loads are indicated or recorded manually or by self-indicating instruments. Two compression-type load weighing cells of 100,000 and 200,000-lb capacities are available, and size range of universal load cells for both compression and tension loads has been extended up to 100,000 lb. To supplement these cells, SR-4 load beams can be supplied to obtain load measurements down to 2 grams full scale.

Eleven sizes of fluid pressure cells are now obtainable, with addition of cell of 10-psi capacity on low end of scale and two cells of 100,000 and 150,000-



psi capacities on high end. In these cells, gages are bonded to outside surface of pressure tube with open end that can be connected into pressure system. Manufacturer: Baldwin Locomotive Works, Philadelphia 42. Pa.

For additional information circle MD 39 on Page 173

#### **Bridge and Amplifier**

This BA-1 bridge and amplifier, a standard cathoderay oscilloscope and SR-4 strain gages form a system adaptable to measuring practically any mechanical reaction. Other resistive units in form of displacement, load, pressure and other pickups are handled effectively. Unit is a complete package of bridge elements, signal chopper, calibration system, amplifier and power supply. Load measurements, stress analysis and function analysis during operation show amplitude, frequency and waveform of sharp transients, steady state oscillations, static loads and their combinations. Displacement, acceleration, vibration, damping, timing, weight and pressure can be seen and measured during operation. Signal chopper frequency is 100 cycles per second, and gain is 0, 10, 150 and 3000 v. Frequency response is flat from 5 to 20,000 cycles per second with negligible phase shift. Power is supplied by batteries with life of 150 hours. Unit is completely portable. Manufacturer: Ellis Associates, Box 77, Pelham 65, N. Y.

For additional information circle MD 40 on Page 173

#### Calibrated Pre-Amplifier

Especially designed to extend sensitivity of line of graphic recorders to 30 microvolts, model PR calibrated preamplifier is an all-purpose self-contained laboratory instrument suitable for portable applications. Unit is avail-



able with selection of input impedances for use with multiplicity of low-output devices. Flat response from 40 to 40,000 cycles per second, dynamic range in excess of 60 db, and calibrated gain control in 5-db steps from 0 to 50 db, gives calibrated amplification into low output impedance. Manufacturer: Sound Apparatus Co., Stirling, N. J.

For additional information circle MD 41 on Page 173

G

75. Oil & Coolant Filtering

Honan-Crane Corp.—Set of four illustrated booklets explains value of filtering oils and coolants used in metalworking operations such as cutting, grinding, boring, honing and quenching. Right method and equipment to handle any problem involving from 1 to 500 machine tools are discussed. four illustrated

76. Bi-Metal Thermostats

Stevens Mfg. Co.—2-page bulletin F-2001 deals with type M bi-metal disk thermostats for use in communications equipment, appliances and electrical apparatus. Thermostat operation, typical response curve and construction data are included.

77. Hydraulic Pumps and Motors
Sundstrand Machine Tool Co., Hydraulic
Div.—4-page illustrated form No. 132 contains
data on PWX circuit pump for both feed and
rapid traverse and fluid motor for infinite
speed selection. Ratings, dimensions and features are listed. tures are listed.

Airborne Accessories Corp.—4-page illustrated circular gives details of improved Rotorac electrically powered right angle type rotary actuator which features high power rating, low weight, built-in radio noise filter, adjustable center position switch for indicating or seeking and optional position indicating transmitter.

79. Powdered Metal Parts

Powdered Metal Products Corp. of America
—S-page illustrated catalog is entitled "Powdered Metal in Your Production Picture."
Featuring self-lubrication, variable density, special alloy properties, economy, precision, good wear resistance and low tool costs, powdered metal can be used for gears, bearings, valves, cams, filters and electronic elements.

80. Heat & Control Engineering

Westinghouse Electric Corp.—16-page illustrated booklet B-4031 tells about Thermaneering heat and control engineering service to aid in properly and efficiently applying controlled heat. Check list of Westinghouse standard thermostats is included which gives capacities, temperature ranges and applications.

81. Hard Surfacing
Coast Metals, Inc.—Hilustrated booklet No.
649 details Hard metal surfacing of parts subject to high abrasion, Given also are production records of Hard cast rolls in metal forming operations,

82. Resistance Welding
Resistance Welding Institute—32-page illustrated booklet entitled "Design for Resistance Welding" explains advanced techniques in resistance welding processes. Theory and application of spot, seam, projection and butt welding are covered.

Welding are covered.

83. Laminated Plastic
Formica Co.—16-page illustrated catalog
"Productive Formica at Work in Industry"
evaluates each of 50 grades of this laminated
thermosetting plastic material on properties
such as water resistance, dimensional stability,
mechanical strength, electrical characteristics,
machinability and chemical resistance. Also
covered are available forms, typical applications and methods of fabrication.

84. Alloy Steel
Jones & Laughlin Steel Corp.—36-page illustrated form No. AD155 contains data on Jalloy special alloy steel which is capable of being heat-treated to excellent physical properties for use where abrasion and impact resistance are major factors in service life. Tables on chemical composition, grain size, surface hardness and yield strength are included.

85. Photoelectric Counters

Photoswitch Inc.—2-page illustrated bulletin 20A1 gives details of several types of photoelectric counters for remote, high speed or selective counting of any type of object. Complete specifications and prices are given for all types of counters.

86. Indicating Pyrometer Controllers
Wheelco Instruments Co.—2-page illustrated bulletin PC-1 describes Panelmount Capacitrol series of indicating pyrometer controllers for temperature, voltage, current, speed and similar variables in process industries. Instrument features Wheelco electronic control principle, drawer-type chassis and complete front access.

87. Totally Exclosed Meter
U. S. Allectrical Motors, Inc.—8-page illustrated bulletin 1524 presents U. S. Unklosed motor of horizontal type available in ratings from ¼ to 250 hp. Features include armorciad asbestos-protected windings, drip-proof housing, Lubriflush jubrication, cyclone ventilation, Centricast rotor and annealed lamina-

Bellows Co.—10-page illustrated bulletin AV100 gives details of standard air valves for remote control of single and double-acting air cylinders. Valves are button, lever, cam, clevis, treadle or foot operated. Two, three and four-way valves are available in %, %. %, % and 1-in. port sizes.

87. Cast Iron
Mechanite Metal Corp.—4-page illustrated bulletin No. 32 presents complete tabular summary of engineering properties of various types of Mechanite castings available to industry. Also included are data important to casting designers concerning property changes as affected by variations in section sizes.

90. Bushings & Adopters
Dodge Mrg. Corp.—o-page illustrated bulletin A-420 discusses Taper-Lock weld-on hubs, bushings and adapters for mounting pulleys, sprockets, sheaves, gear or other hubs on shafting. Installation and removal are illustrated and sizes and specifications given.

91. Huld Filters

Commercial Filters Corp.—4-page illustrated bulletin No. 1000-B-2 gives details of Fuliow filters and Honeycomb filter tube for clarification of wide range of liquids and gases. Principle of operation, applications, tube densities, capacities, filter sizes and variety of models are described.

92. Hydramic Tubing
Superior Tube Co.—4-page illustrated bulletin No. 38 gives general and technical information as well as specifications on line of
seamless steel hydraulic tubing from % to
1%-in. OD, in wall thicknesses for every
practical operating pressure.

93. Castom-Cat Geors

Perkins Machine & Gear Co.—4-page illustrated folder on custom-cut metallic or non-metallic gears presents typical applications that include washing and ironing machines, aircraft engines and accessories, machine tools, precision instruments, coal stokers, hoists and rumps.

94. Specialized Fastenings

Shakeproof, Inc.—12-page form AS-31 is entitled "Fastening Analysis by Shakeproof" and tells of specialized fastenings service. Brief case histories show economies that have been achieved in variety of industries through proper fastenings which simplify design and eliminate unnecessary parts and operations.

#### FOR MORE INFORMATION

on developments in "New Parts" and "Engineering Department" sections-or if "Helpful Literature" is desired-circle corresponding numbers on either card below

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95. Speed Control
Reeves Pulley Co.—12-page illustrated folder C471 discusses applications, operating principles and advantages of Reeves speed control to provide any driven machine with accurate stepless speed adjustability. It can be used to widen work range of machines, assure accurate timing, compensate for changes in consistency of materials and closely regulate conveyor speeds. conveyor speeds.

96. Zinc Base Metals

Ye. Zinc Base Metals

American Nickeloid Co.—Illustrated folder explains available types of zinc base metals furnished in sheets, coils or flat strips. Samples of both bright and satin finished metals are included. Material can be supplied plated on one or both sides in striped or crimped patterns. These preplated metals can be stamped, blanked, bent or formed to meet most design requirements.

97. Metal Powders

77. Metal Powders

National Radiator Co., Plastic Metals Div.—
4-page illustrated bulletin No. 567 deals with
various grades of iron powder as well as
nickel, manganese, silicon and other nonferrous powders. Shown are various parts that
can be fabricated from metal powders and
number of special uses to which they can be
applied.

98. Precision Gears

Massachusetts Gear & Tool Co.—4-page illustrated bulletin No. 49328 lists available diametral pitches, pitch or outside diameters
and face lengths or lengths of spur, helical,
straight bevel, face and worm gears; worms;
generated pinion rod; racks; ratchets; sprockets and miscellaneous gear types.

99. Hydraulic Cylinders

77. Hydraulic Cylinders
Hydraulic Equipment Co.—4-page illustrated folder No. C-20649 is on standard design, single and double-acting cylinder assemblies. Recommended operating pressures, effective diameter, stroke required and other vital information are given.

100. Nonferrous Castings
Wellman Bronze & Aluminum Co.—16-page
illustrated catalog No. 50 describes nonferrous
castings and wood and metal pattern operations. Included are data on magnesium alloys,
polishing of aluminum, Well-Castings, copper
base alloys and Ampco pattern shrinkages.

101. Copper Abrasive

American Wheelabrator & Equipment Co.—
4-page illustrated bulletin No. 69 explains advantages of using copper shot for blast cleaning and finishing nonferrous metal parts. Performance results are enumerated and advantages listed.

102. Spray Lubricators
Frontier Industries, Inc., Manzel Div.—4page illustrated bulletin "Manzel Spray Lubricating System" explains operation of the
quipment which lubricates punch and shear
operations. Utilizing force-feed principle, unit
applies adjustable amount of lubricant directly to punch, die, shear or other tool at
each stroke. each stroke.

103. Analyzing Instruments
Century Geophysical Corp.—Five illustrated bulletins present complete details on line of equipment which includes five recording oscillographs, two galvanometers, two oscillographs and amplifier for use with analyzing

104. Relays
Sterling Engineering Co.—4-page illustrated bulletin No. 110 is devoted to type GS short form telephone relays. Spring assemblies, dimensions, contact arrangements and voltages are listed.

105. Metal Fabrication
L. O. Koven & Brother, Inc.—24-page illustrated bulletin No. 490 is entitled "Men, Facilities and "Know How"". Production and engineering facilities for fabrication of metals in all gages from 18-gage to heaviest plate are described.

106. High-Vacuum Pumps
F. J. Stokes Machine Co.—32-page illustrated catalog No. 700 contains engineering information, specifications and other data relative to Microvac high-vacuum pumps and their use in producing pressures as low as 0.00002 psis. Many industrial applications are listed, installations shown, and typical problems and their solutions presented.

107. Battery Chargers

Electric Products Co.—4-page illustrated bulletin 234 outlines design features of type S single-circuit motor-generator battery charging equipment. Units are available in wide range of sizes to handle both lead-acid and Edison types of industrial storage batteries.

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108. Stainless Pipe & Tubing
Babcock & Wilcox Tubing Co.—4-page flustrated bulletin TDC-'30 deals with Croloy
18-88 type 304 stainless pipe and tubing.
Condensed data are presented on corrosion resistance, creep strength, oxidation resistance, mechanical properties, machinability, welding characteristics, heat treatment and physical properties.

109. Heat Exchange Coil

Kold-Hold Mfg. Co., Platecoil Div.—4-page illustrated bulletin I-49 explains how Platecoil units eliminate many problems in tank heating and cooling applications. Available sizes, heat exchange surfaces and typical applications are covered also.

110. Stampings & Forgings
Commercial Shearing & Stamping Co.—28page illustrated brochure presents design factors, applications and advantages of line of
stampings, forgings, hydraulic equipment and
assembled products that are 'Factory Fash-

111. Fastening Specialties

South Chester Corp.—28-page illustrated manual is entitled "Fastening Specialties Handbook." Descriptive and engineering data are presented on Southco blind rivets, anchor nuts, panel fasteners, door-retaining springs and other specialties for fastening metal to metal or to wood.

112. Flexible Hose Assemblies

Resistoriex Corp.—4-page illustrated bulletin "Synthetic Flexible Products and Parts for Industry" describes Compar-tubed flexible hose assemblies for original equipment. Typical uses such as in hydraulic, refrigerant, lubrica-tion and chemical lines are cited.

113. High Current Resistor

Exmet Electrical Corp.—6-page illustrated folder describes Multipath high current resistor for industrial, marine and transportation applications. Typical uses of this unit include low-cost large-quantity power disposal, radiant heating at 'black' temperature and forced draft heating. heating at draft heating.

114. Gear Drives & Reducers
Universal Gear Corp.—8-page illustrated bulletin "Universal Uses of Our Units" shows and briefly describes various types of gear drives and speed reducers in range of % to 10,000 horsepower. Heliocentric principle used in high ratio concentric universal units is explained and covered by sectional drawing.

115. Magaetic Relays
Ward Leonard Electric Co.—12-page illustrated catalog D-20A contains descriptions of seven standard types of magnetic relays for industrial and general-purpose control applications. Complete technical data on relay ratings, dimensions, coil specifications and applications are included.

116. Passmatic Controls

Bendix-Westinghouse Automotive Air Brake Co.—18-page illustrated bulletin "Robotair Industrial Air Controls" explains use of shortstroke chambers, medium-stroke units, two and three-way valves, pressure regulating and quick-release valves, filters, checks, gages, air reservoirs and tubing fittings as components of complete machines and mechanisms.

117. Low Melting-Point Alloys

Cerro de Pasco Copper Corp.—4-page illustrated folder J4-6-49 lists all known applications of low-temperature-meiting Cerro alloys. Characteristics of materials which expand when changing from liquid to solid are explained. Physical properties of available types of alloys are outlined briefly.

118. Vacuum Coatings

Distillation Products, Inc.—12-page illustrated booklet entitled "Vaporized Metal Coatings by High Vacuum" describes standard units for vacuum coating various objects. Burfaces produced have greater brilliance than depositions applied either by electrolysis or as paint and require no hand finishing or buffing. Method can be employed on many surfaces including glass, plastics, paper, metal, crystals, cloth or any substance that retains its solid state and does not have too high vapor pressure under high vacuum.

119. Precision Parts

119. Precision Forts

Kohler Co.—24-page illustrated catalog describes precision air and hydraulic parts produced for aircraft, industrial and automotive manufacturers. Complete data including connections, operating pressures, open pressures, rates of flow, sizes, pressure drop, material and weight are given for each product.

120. Capacitors

Stackpole Carbon Co.—4-page illustrated form RC 7E-1500 deals with characteristics, performance and testing of GA capacitors that can be obtained in six standard capacities ranging from ½ to 4.7 micromicrofarads. Dimensions and color coding are also given.



- Good machinability, minimum metal removal
- Attractive appearance
- · High corrosion resistance



INGOT - SHEET & PLATE - SHAPES, ROLLED & EXTRUDED - WIRE - ROD - MAR - TUDING - PIPE - SAND, DIE & PERMANENT MOLD CASTINGS - FORGINGS - IMPACT EXTRUSIONS ELECTRICAL CONDUCTORS - SCREW MACHINE PRODUCTS - FABRUATED PRODUCTS - FASTENERS - FOIL - ALUMINUM PIGMENTS - MAGNESIUM PRODUCTS



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A Cambridge Balanced Belt safely and speedily carries clock faces through the decorating lehr. In a modern ceramics plant, Cambridge belts can also be used for annealing and glazing. Open mesh permits free heat circulation around the ware. Moving belt eliminates use of cars or saggers.

Whether your product is big and bulky or small and fragile, if it must move during processing or production, a Cambridge Woven Wire Conveyor Belt can do the job economically and safely.

Woven from any metal or alloy to any mesh or weave, Cambridge belts offer dependability, long life, freedom from time-wasting shutdowns for repairs. Among the specially designed Cambridge belts in service today are continuous conveyorized installations for baking, quenching, tempering, washing, drying, cooling and packaging.

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### Cambridge Wire Cloth Co.

Wire cloth

Also specialized wire fabrications

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OFFICES IN PRINCIPAL INDUSTRIAL CITIES

James D. Cunningham, president of Republic Flow Meters Co., Chicago, will take office as president of The American Society of Mechanical Engineers at the end of the annual meeting in New York in December. He will succeed James M. Todd, consulting engineer of New Orleans. Regional vice presidents taking office at the same time will include Frank M. Gunby of Chas. T. Mann Inc., Boston; John C. Reed, head of mechanical engineering department. Bucknell University, Lewisburg, Pa.: Albert C. Pasini, assistant superintendent, production department, Detroit Edison Co., Detroit: and Samuel H. Graf, director of engineering experimental station, Oregon State College, Corvallis, Ore. Directors at large will be Thomas E. Purcell and Benjamin P. Graves.





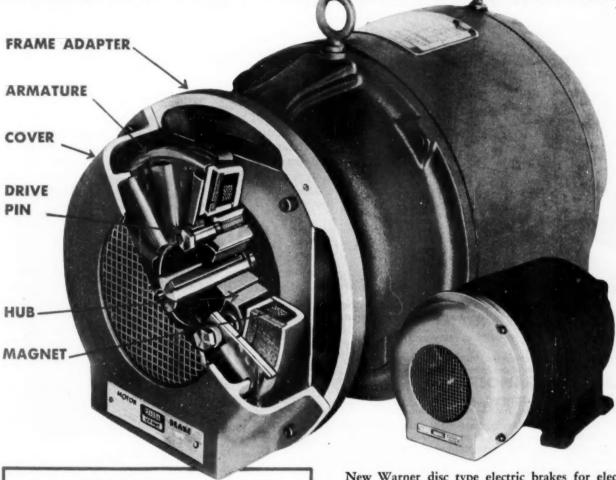


G. K. Egglesion

Appointment of G. K. Eggleston as vice president in charge of manufacturing of Non-Ferrous Perma Mold Inc., Mansfield, Ohio has been announced. Owned jointly by the Barnes Manufacturing Co. of Mansfield and the Non-Ferrous Die Casting Co. Ltd. of London, Eng., this new corporation manufactures permanentmold castings. Prior to his present appointment, Mr. Eggleston was vice president of engineering for the Barnes Manufacturing Co. From 1922 to 1941 he was with the Detroit Lubricator Co.

According to a recent announcement Edgard C. DeSmet has been named to the newly created post of director of body engineering for Willys-Overland Motors Inc., Toledo, Ohio. In addition to his present duties as head of the styling department he will be

ANNOUNCING A NEW DISC TYPE BRAKE FOR ELECTRIC MOTORS



## THIS REVOLUTIONARY NEW BRAKE GIVES YOU ALL THESE ADVANTAGES:

- Instant Operation
- Fast Controlled STOPPING
- NO adjustment for life
- Unmatched ability to dissipate heat
- Fewer parts
- Compactness and ease of installation
- Low power requirements max. 25-35 watts
- Low cost installation and maintenance

### POWER CONVERSION UNIT

Warner brake coils are wound for full current application of 90 Volts D.C. D.C. power may be obtained from a D.C. source or any standard A.C. supply with a Warner conversion unit. Warner con-



conversion unit. Warner conversion units supply a maximum of .40 amperes at 90 Volts D.C. when connected to any A.C. voltage source.

New Warner disc type electric brakes for electric motors exert a constantly increasing torque throughout stopping period. Standard units now available for horizontal shaft mounting. All Warner disc type electric brakes for electric motors are designed to fit NEMA motor specifications. These units have been thoroughly field tested and yield amazingly practical results. Write today for complete information.

WARNER ICB UNIT Warner Electric Brakes for Transportation and Industry Since 1927

WARNER ELECTRIC BRAKE MFG. CO. BELOIT, WISCONSIN

Please send me bulletin 702 with complete information on Warner Electric Disc-Type Brakes for Electric Motors.

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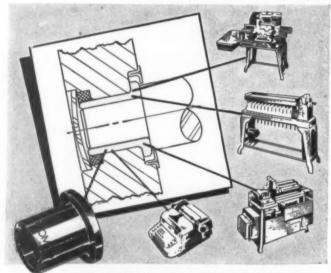
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SELF-LUBRICATING BEARINGS

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Switching to Bound Brook "COMPO" Self-Lubricating Flanged Bearings meant more than providing for severe end thrust. It meant:

To the manufacturers:

 Simplification of design, quicker, lower cost assembly and elimination of costly machining operations.

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 No periodic lubrication, maintenance costs cut, and continuous, quiet, trouble-free operation.

"COMPO" Porous Bronze Bearings are made from pure metal powders, die-formed to shape, alloyed at high temperatures, finished to exact dimensions, and vacuum-impregnated with lubricant. Self-lubricating qualities make them ideal for use in inaccessible spots. The lubricant is sealed in, free from dirt, and an even lubricating film is always present.

Thousands of "COMPO" Bearing sizes can be made from existing dies; hundreds of sizes in stock for prompt shipment. Use coupon below, to get our free Stock List or arrange a conference with one of our engineers. We've saved time and costs for others; we can do the same for you.

Many other types of "COMPO" Bearings and "COMPO" structural parts have been designed into business machines, appliances and other types of equipment at equal savings and with equal performance benefits.

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responsible for planning and directing all body engineering at Willys. Joining the company in 1936 as body engineer, he has served successively as assistant chief engineer, chief engineer of the wartime aircraft division, and assistant to the vice president in charge of engineering. Prior to joining Willys-Overland he was with the Locomobile Co., Dodge Bros., Briggs Mfg. Co., Hudson Motor Car Co., and Chrysler Corp.

S. W. Steininger has become design engineer for Fairchild Engine & Airplane Corp., Oak Ridge, Tenn. He previously held a similar position with the Hercules Motors Corp., Canton, Ohio.

Appointment of William A. Wilson as associate professor of mechanical engineering at the Massachusetts Institute of Technology has been announced. A graduate of Columbia University, Professor Wilson's industrial experience includes six years with Westinghouse Electric Corp. as experimental engineer on steam turbines, and seven years as mechanical division engineer at the Elliott Co.

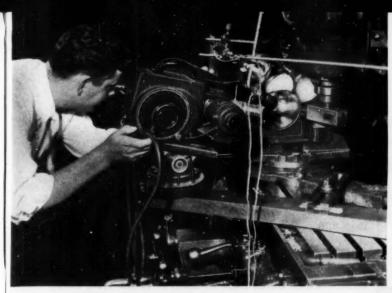
Elected to the newly created post of executive vice president of the De Vilbiss Co., Toledo, Ohio, is Ray L. Morrison. He has been general manager of the brake division of Timken-Detroit Axle Co., and previous to that was vice president and general manager of Bendix-Westinghouse in Pittsburgh and Elyria.

Jules P. Kovacs has been elected vice president in charge of engineering of Purolator Products Inc.. Newark, N. J. Having joined Purolator as a design engineer in 1929, he was appointed chief engineer in 1941.

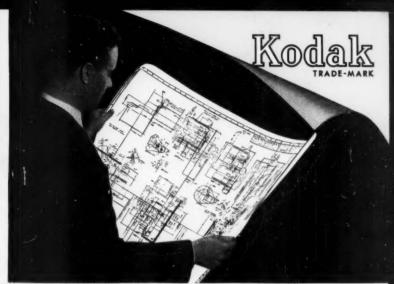
Thomas D. Jolly, vice president in charge of engineering and purchases, Aluminum Company of America, Pittsburgh, was re-elected president of the American Standards Assn. Harold S. Osborne, chief engineer of American Telephone & Telegraph Co., New York, was re-elected vice president.

Harry G. Bolton has recently been appointed chief engineer of the Marvel-Schebler Carbureter Division of Borg-Warner Corp., Flint, Mich. He has been associated with the engineering department of the division since 1928 and in 1940 was appointed assistant chief engineer.

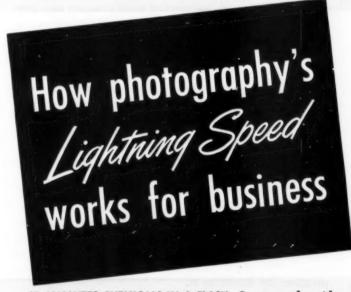
Election of Chester M. MacChesney as chairman of the board of directors of Acme Steel Co., Chicago, has been announced. He became associated with Acme in 1916 as a design engineer and in 1948 was made executive vice president.



IT HELPS IMPROVE PRODUCTS—High speed movies provide a record of motion far too fast to see. With the Kodak High Speed Camera, a second becomes three minutes, so you can see and analyze rapid movement—spot faulty action and points of excessive wear—see ways to make a better product.



IT COPIES DATA IN SECONDS—Engineering drawings, shop orders, specifications, records, and letters of all kinds can be copied fast, and with utmost accuracy. Photocopying with Kodagraph Papers, Cloths, and Film saves time, protects originals from wear and tear—even permits producing clean, legible copies from faded or worn material.



IT ANALYZES CHEMICALS IN A FLASH—Spectrography with Kodak Spectrum Analysis Film and Plates quickly determines the composition of almost all materials. It provides a means to make frequent production-line analyses. It can maintain a check on specifications and speed up output.

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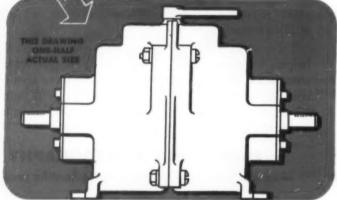
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MODEL 10-SPECIFICATIONS

H.P. OUTPUT — 1/15 H.P.
INPUT SPEED — 1800 RPM standard — other as required
OUTPUT SPEED — from 2/3 input speed to zero and reverse
TORQUE — 50 in. oz.
CONTROL — Finger-tip lever — 60° motion
LUBRICATION — sealed-in oil or grease

OTHER SIZES UP TO THREE HP — For quick delivery of a Model 10 or full data on the Graham line, use the coupon, or return the Reader Service Card inserted in this magazine.

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### OF MANUFACTURERS

Purchase of all machinery, tools, inventory, buildings and real estate of Cords Ltd., 780 Frelinghuysen Ave., Newark, N. J., has been announced by Essex Wire Corp., manufacturer of wire and wire products. The new owner will continue to operate this business in Newark as Cords Ltd., Division of Essex Wire Corp.

Victor Equipment Co., San Francisco, Calif., has announced the purchase of the business and assets of Mills Alloys Inc., 11320 Alameda St., Los Angeles, Calif. The manufacturing facilities purchased by Victor will continue to be located at the leased site now occupied by Mills Alloys and will be designated as the Alloy Rod and Metal Division of Victor Equipment Co.

The United Engineering Co. has announced the completion of a new department devoted entirely to high-precision machine shop work at United's San Francisco plant, 500 Beale St. The shop, with \$175,000 worth of precision tools, is at work on intricate machinery for aircraft manufacturers and radar equipment for use by the Navy.

Cone-Drive Gears, Division of Michigan Tool Co., Detroit, Mich., has announced the purchase of the Twelfth St., Traverse City, Mich., plant of Parsons Corp. The plant, built during the war, covers approximately 40,000 sq ft.

Non-Ferrous Perma Mold Inc., a new company jointly owned by the Barnes Mfg. Co., Mansfield, O., and the Non-Ferrous Die Casting Co. Ltd., London, England, has been incorporated under the laws of the State of Ohio, with factories in Mansfield, Ohio. British process techniques have been brought here through the formation of this new corporation.

Assets of The O. K. Tool Co., Shelton, Conn., manufacturer of single point and inserted blade type milling cutters, have been acquired by Williams & Hussey Machine Co., Wilton, N. H., manufacturer of special machinery and "Star" gages.

The Pickering Governor Co., Portland, Conn., manufacturer of governors, has been acquired by the Henry & Wright Division of Hartford-Empire Co., manufacturer of high-speed presses for continuous die work and other special machinery. The parent com-



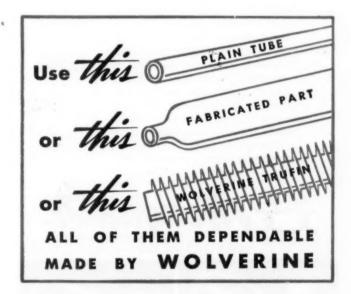
It's not always easy to put your finger on the exact places where economies in manufacturing can be affected.

Sometimes these economies are found outside your own manufacturing processes—among the assembled parts—brought in by suppliers of the various components making up your product.

If tubing or tubular parts form a part of the products you make—it's to your advantage to see that such components are supplied by specialists —specialists like Wolverine Tube, who have been manufacturing tubing exclusively for over thirty years. To draw on this wealth of experience means economies to you. We can help you (just as we have helped thousands of other manufacturers) to utilize tubing—plain, finned (Wolverine Trufin) or fabricated—in a way that can reduce your manufacturing costs. We have shown many manufacturers, for instance, how they could make their tubular parts more economically by using tube than by continuing with the method they were

employing. We have also pointed out ways to substantial economies, where heat transfer is involved, through the use of Wolverine Trufin (the integral finned tube).

Wouldn't you like to learn more about these economies? Have one of our engineers call on you to discuss these matters. No obligation.





WOLVERINE TUBE DIVISION
CALUMET AND HECLA CONSOLIDATED COPPER COMPANY

MANUFACTURERS OF SEAMLESS NON-FERROUS TUBING

1433 CENTRAL AVENUE

DETROIT 9, MICHIGAN

PROBLEM: Outboard bearings on extended pin roller chain conveyor... to withstand degreasing vapor, dipping bath fumes, high heat, water dip, steam, phosphoric acid spray.

**SOLUTION:** A Morganite bearing . . . the special bearing for special conditions . . . meets all requirements . . . is entirely self-lubricating under all conditions.

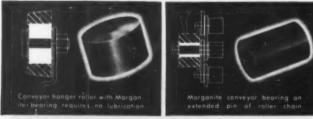


demonstrates the special properties of
Morganite bearings is their use on
conveyor belts involving continuous
changes of atmosphere and temperature.
Bearings, pump blades and seal rings of
Morganite easily withstand these
conditions... actually operate better
when submerged in liquids. They are
immune to oil, petroleum, water, brine,
most acids and alkalies. Being selflubricating they do not contaminate
contacting liquids and materials with
grease or oil, impart no odor or taste.



Additional data on Marganita will be found in Sweet's File for Product Designers. For competent engineering help on specific problems consult a Marganite sales engineer. There is no obligation.





Manufacturers of Morganite Carbon Brushes for all motor and generator applications, and Morganite Carbon Piles.

pany, Hartford-Empire, manufacturer of glass container machinery, has as its other associates: Plex Corp. Division, developer of machinery for extruding and blowing various plastics materials which it markets; and the Standard-Knapp Division, manufacturer of packaging machinery.

Allied I search Products Inc., Baltimore, Md., manufacturer of Iridite finishes, has purchased the building at 4004 E. Monument St., which has housed the company for the past three years. Plans are being drawn for extensive interior renovations which will include larger research and manufacturing facilities, increased space for metal finishing operations, and new administrative and sales offices.

Quarters of Kraus Design Inc., manufacturer of automatic parts and handling equipment, have been moved to 950 Exchange St., Rochester 8, New York.

All the properties and assets of **DeWalt Inc.**, manufacturer of radial saws for high-speed cutting of wood, light metals and plastics, have been purchased by **American Machine and Foundry Co.**, New York, N. Y. AMF will continue operation of the 75,000-sq ft plant, at Lancaster, Pa., with the present personnel through a wholly-owned subcidiary.

The Pittsburgh Plate Glass Co., Pittsburgh, Pa., has announced plans for the construction of a paint plant at Torrance, Calif. The plant, which will have 157,000 sq ft of floor space, loading docks and covered walkways, is expected to go into production within ten to twelve months.

Logan Engineering Co. has announced the merging of the Dor-O-Matic Co. into the Logan organization. Manufacture of the Dor-O-Matic door control has been transferred from the Dor-O-Matic factory, 818 S. Kolmar Ave., Chicago, Ill., to the recently enlarged Logan Engineering plant, 4901 West Lawrence Ave., Chicago, Ill. In addition to the activities of its new Dor-O-Matic Door Control Division. Logan Engineering will continue the manufacture of Logan lathes at the Lawrence Ave. plant.

Opening of a new 45,000-sq ft plant located at 3203 South Wayside, Houston, Tex., has been announced by the Link-Belt Co., manufacturer of chains, elevators, conveyors and power-transmitting machinery.

A 30-minute technicolor sound film, "This Moving World," has been produced for the Malleable Founders' Society, Cleveland, O., by Roland Reed Productions, Hollywood, Calif. The film tells in dramatic fashion the part played in the industrial world by malleable castings.



### Maybe you can profit by steel mill experience

THIS conveyor roll is going to save a steel mill some money. Because it is a Shenango-Penn centrifugal casting of Meehanite Metal, it will hold up longer than an ordinary roll... won't need replacement nearly so soon! That's good economy, don't you think?

Fundamentally that's why Shenango-Penn is producing symmetrical, annular and tubular parts, large and small, ferrous and non-ferrous, for many services in many industries. The Shenango-Penn centrifugal casting process results in more

uniform, pressure-dense parts with finer grain, greater strength, superior wear resistance and freedom from sand inclusions and blow holes. Metal for metal, dollar for dollar, they do a better job. It pays!

As always, we welcome the chance to give you further evidence, specific facts, as to why it will pay you to specify Shenango-Penn. Send for a free bulletin on our ferrous or non-ferrous made-to-order centrifugal castings or on our centrifugally cast bronze bushing stock in standard sizes.

### SHENANGO-PENN MOLD COMPANY

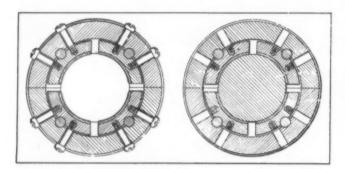
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ALL BRONZES - MONEL METAL NI-RESIST - MECHANITE METAL

## PATENTS

TILTING PAD BEARINGS for rotating shafts are made by a unique method described in patent 2,480,-114. Several circumferential bearing pads are shimmed and held to an outer shell by screws while



the bore is machined and an axial hole is drilled between each pad and the shell to receive a cylindrical pin. The screws and shims are then removed, leaving the pads free to rock on the pins to provide the desirable wedge-film clearance. The bearing design is especially effective in reducing low-frequency vibrations caused by dynamic instability in an oil film when rotational speeds are high and weights low. The patent has been assigned to Westinghouse Electric Corp. by Donald Bradbury.

VARYING CAPACITANCE between two metallic sleeves fastened to a torsionally loaded rotating shaft can be used to indicate the torque being transmitted. The two sleeves are insulated electrically from the shaft and are mounted on it at their outer ends only, so that any twisting of the shaft causes a relative angular displacement of the toothed, inner, opposed ends of the sleeves. The electrical capacity between the two sleeves is thus varied and can be detected quantitatively using an appropriate bridge circuit, giving a direct indication of the torque being transmitted by the shaft. The device, covered in patent 2,476,410 and assigned to General Motors Corp. by Arthur W. Gardiner, was first developed to enable aircraft pilots to obtain the same power output on each of several shafts, thereby utilizing fuel more efficiently.

Locking action of an internally threaded pinion prevents spinning of a drive wheel in the differential mechanism described in patent 2,479,638, assigned to the Dualoc Engineering Co. by Ralph R. Randall. Input bevel gear is fastened to a housing or rotating gear carrier which contains two bearing plates that rotate with the carrier, a series of planet pinions, and an axle gear for each of the drive wheels.





### PERMA-TUBE may be used for many applications where strength, rigidity, rust-resistance, and attractive appearance are necessary.

By using the new exclusive rustresisting J&L PERMA-TUBE for the vertical mast and cross-arms in the "Minute-Man" series of television antennas, Ward Products Corporation, Division of the Gabriel Company, Cleveland, Ohio, buildsin the following advantages:

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J&L PERMA-TUBE is a lightwall, electricweld steel tubing, coated inside and out with an exclusive plastic-type, weather-resistant finish. PERMA-TUBE can be furnished: bent . . . expanded . . . flanged . . . swaged or fluted.

J&L PERMA-TUBE for television antennas, costs less than any other tubing with comparable strength, rigidity and rust-resistance.

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applicable to television antennas, but also wherever strength, rigidity and rust-resistance are important. It is available in all regular sizes and shapes of J&L Electricweld Tubing and in lengths up to 10 feet. Return the coupon TODAY for complete information on this new J&L product.

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Please send me complete information on the new J&L STEEL PERMA-TUBE mechanical tubing.

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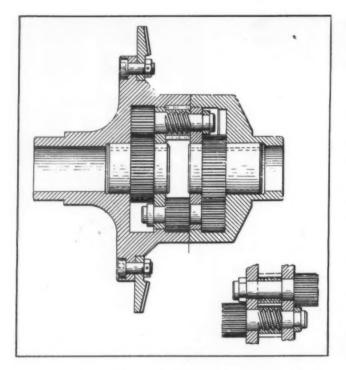
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### JONES & LAUGHLIN STEEL CORPORATION

From its own raw materials, J&L manufactures afull line of carbon steel products, as well as certain products in OTISCOLOY and JALLOY (hi-tensile steels).

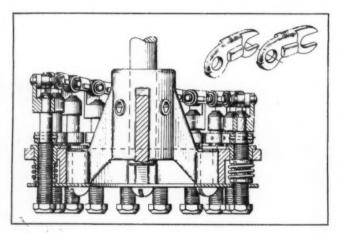
PRINCIPAL PRODUCTS: HOT ROLLED AND COLD FINISHED BARS AND SHAPES . STRUCTURAL SHAPES . HOT AND COLD ROLLED STRIP AND SHEETS . TUBULAR, WIRE AND TIN MILL PRODUCTS . "PRECISIONBILT" WIRE ROPE . COAL CHEMICALS



Supported between the bearing plates and geared to one of the axle gears are several screw threaded shafts each carrying an internally threaded pinion. Each threaded pinion, in turn, meshes with another pinion fixed to a parallel shaft which is geared to the second axle gear. Any appreciable difference in the torque delivered by the two drive wheels causes

the screw threaded shafts to rotate, thereby moving the internally threaded gears axially until they clamp one or the other of the bearing plates, locking the entire gear train and driving both wheels.

A DJUSTABLE CAM TRACK made up of slotted links furnishes any desired profile in a mechanism patented by Otto Mohr and assigned to Bell Telephone Laboratories. Each link in the cam-track chain has one end secured to the upper end of a set screw or positioning rod, the slotted end being free to move on a pin fastened on the upper end of the adjacent rod. Vertical positioning of these threaded rods determines the cam profile. The device is described in patent 2,480,594.



ERE'S MOTOR EXPERIENCE THAT

CAN BE YOURS

• A high percentage of all Peerless Motors are manufactured to meet the specific operating requirements of the equipment with which they are to be used. Answering these motor problems has given Peerless engineers an experience that can be yours when you call Peerless for advice on motor applications.

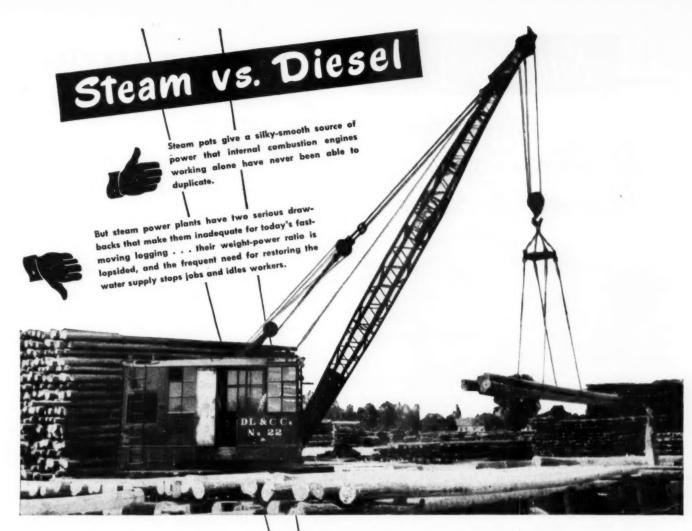
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## How to Get Steam Smooth Performance from a

Diesel Engine

Hydraulic Torque Converter







To combine the smooth power advantages of steam and the economy of Diesel power, Dierks Lumber and Coal Co., of De Queen, Ark., recently installed a Twin Disc Hydraulic Torque Converter (Lysholm-Smith type) in their 25-ton crane when they converted it to Diesel power.

The Orton crane now operates 16 hours a day with no interruptions. Except for a simple clutch lever on the torque converter, no original controls were added or changed. Besides providing steam power performance, the Twin Disc Torque Converter multiplies torque up to five times . . . enables the crane to push a 100-ton load with ease. Sluicing and road travel are smoother, faster, and there is less swing of the suspended load.

Ask your nearest Twin Disc dealer for details on converting steam to Diesel or gasoline power, or write Twin Disc today for Bulletin No. 135-C. TWIN DISC CLUTCH COMPANY, Racine, Wisconsin, (Hydraulic Division, Rockford, Illinois).







IN INDUSTRIAL CLUTCHES SINCE



## Silicone News

## Here's How DC Silicone Insulation Reduces Motor Failure

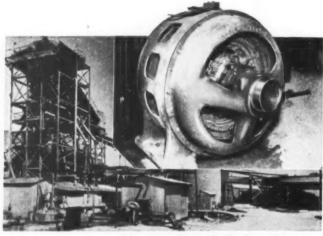


Photo courtesy Virginia-Carolina Chemical Corp.

THIS 300-H.P. silicone insulated motor was back in service three hours after being flooded with water, mud and waste.

e Engineers of Virginia-Carolina Chemical Corporation agree that DC Silicone Insulation is the best solution to motor failure caused by excessive moisture. They proved this in two identical 300-h.p. motors, one wound with Silicone (Class H) and the other with Class B insulating materials. Located side by side and exposed to the same operating conditions, these motors are used to pump waste materials at the Phosphate Mine in Homeland, Florida. After the main line broke last year and flooded both motors with water, mud and waste, the Class B motor had to be reworked and rebaked. The motor wound with Class H insulation was simply cleaned with an air hose and the bearings were flushed out . . . Three hours later, the SILICONE INSULATED motor was back in service and operating perfectly.

That confirms again the fact established by 4 years of motor testing: Class H Insulation made with Dow Corning Silicones has at least 10 times the life and 10 times the wet insulation resistance of the best insulating materials previously available. For more information on how silicone insulated equipment can save you time and money, phone our nearest branch office or write for booklet W-12.

### DOW CORNING CORPORATION MIDLAND, MICHIGAN

Atlanta • Chicago • Cleveland • Dallas
Los Angeles • New York
In Canada: Fiberglas Canada, Ltd., Toronto
In England: Albright and Wilson, Ltd., London



### SALES AND SERVICE



THE NEWLY FORMED industrial division of Greer Hydraulics Inc., Brooklyn, N. Y., has been placed under the direction of Michael Joseph Phillips, new general manager. Mr. Phillips will supervise the production and marketing of Greer hydro-pneumatic accumulators and other hydraulic components for industry. He formerly was Commander of the Production Division, U. S. Navy Bureau of Aeronautics, assistant to the president of Jack & Heintz Precision Industries Inc., assistant chief engineer of Pesco Products and manufacturing vice president of Universal Business Machine Co.

Formerly assistant district sales manager of the Chicago branch, mechanical goods division of United States Rubber Co., Joseph A. Conlon has been named to succeed William T. Keenan, who is retiring as district sales manager of the Chicago office.

All sales operations for Yale & Towne Mfg. Co. trirotor pumps will be directed by William D. Jameson. who has recently been appointed sales manager of the Stamford Division of the company. Before joining Yale & Towne, Mr. Jameson was sales manager of Commonwealth Engineering Co. of Dayton, O. Previously, he was district sales engineer for Blaw-Knox Co., and prior to that he owned and operated Art-Lore Co., a small manufacturer of automobile accessories in New York City.

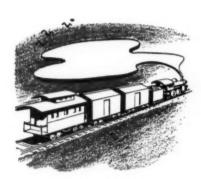
The A. F. Holden Co. of New Haven, Conn. and Detroit has announced the appointment of Lloyd J. Bohan as West Coast representative. Mr. Bohan has been associated with the metal working industries for fourteen years and for the past two years has been a manufacturer's agent in southern California, specializing in heat treating equipment.

The Cooper Alloy Foundry Co., Hillside, N. J., announced recently the promotion of Jack Victorine and Morton C. Meyers to the position of general sales manager and assistant sales manager, respectively. Mr. Victorine has been connected with the stainless casting field at Cooper Alloy for the past seventeen years and has been sales manager for eight years. Mr. Meyers has been associated with the company for twelve years, serving as direct assistant to Mr. Victorine since 1945. Also, J. L. Lessman has been named to serve under Mr. Victorine as manager of valve and fitting sales.

A. J. Jennings, vice president in charge of sales, the Cleveland Worm & Gear Co., Cleveland, and of its associate company, the Farval Corp., died following a heart attack October 30, 1949. Mr. Jennings began his business career with the E. F. Houghton Co. of Philadelphia. After fourteen years he left Houghton to become vice president and general manager of Lubrication Devices Inc. of Battle Creek, Mich., predecessor company

## **OSTUCO TUBING**

### speeds your deliveries 3 ways



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Complete modern facilities for manufacturing, shaping, and fabricating tubing, all at one plant, make it unnecessary for you to have materials shipped from one supplier or one location to another.



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Your own manufacturing or assembly operations run more smoothly because OSTUCO's unified control of production greatly reduces number of rejects and assures highest quality all down the line.

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OSTUCO produces both seamless and electric-welded steel tubing in a broad range of sizes and shapes . . . meets your most exacting requirements in bending, reducing,

expanding, flanging, upsetting, in fact all types of forging and fabricating operations. We are also in a position to supply the tubes painted or plated. An experienced OSTUCO Tubing Engineer will be glad to discuss your particular problems without obligation. Write direct or to our nearest Sales Office. Ask for new free booklet "Fabricating and Forging Steel Tubing."



### THE OHIO SEAMLESS TUBE COMPANY

Manufacturers and Fabricators of Seamless and Electric-Welded Steel Tubing
Plant and General Offices: SHELBY 5, OHIO



Sales Offices: CHICAGO, Civic Opera Bldg., 20 North Wacker Dr. • CLEVELAND, 1328 Citizens Bldg. • DAYTON, 511 Salem Avenue • DETROIT, 2857 E. Grand Blvd. • HOUSTON, 6833 Avenue W, Central Park • LOS ANGELES, Suite 300-170, So. Beverly Drive, Beverly Hills • MOLINE, 617 15th St. • NEW YORK, 70 East 45th St. • PHILADELPHIA, 1413 Packard Bldg., 15th & Chestnut • ST. LOUIS, 1230 North Main St. • SEATTLE, 3104 Smith Tower • SYRACUSE, 501 Roberts Ave. CANADIAN REPRESENTATIVE: Railway & Power (orp., Ltd., NEW GLASGOW, MONTREAL, NORANDA, NORTH BAY, TORONTO, HAMILTON, WINDSOR, WINNIPEG, EIMONTON, VANCOUVER



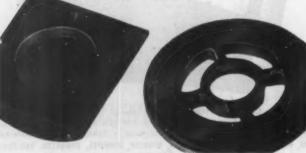
solves many problems

> caused by sliding or rotating parts which are difficult or impossible to lubricate

A constantly increasing stream of problems are facing engineers and designers today involving sliding or rotating parts where lubrication is difficult or impossible. For such applications, Purebon, the mechanical carbon, is often the ideal answer. Typical applications are seal rings, bearings, pistons, piston rings, pump vanes, valve seats, meter discs, and a host of similar items. Purebon comes in a wide variety of grades. It is strong, tough, readily machineable and in many cases can be molded directly to size.

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PURE CARBON CO., INC.



to the Farval Corp. He came to Cleveland in 1932 when Farval was purchased by the Cleveland Worm & Gear Co. As one of the early and most active figures in the American Society of Lubrication Engineers, Mr. Jennings served on its committees and delivered many papers before the national meetings of the Society. He was also active in the American Gear Manufacturers Association, serving at the time of his death as Chairman of the General Commercial Committee.

President of the National Screw & Mfg. Co., Cleveland, H. P. Ladds has been elected to the board of directors of Lock Thread Corp., Detroit.

Max L. Murdock, acting manager of the centrifugal pump department at Allis-Chalmers Norwood, O., works, has been promoted to manager of the department succeeding H. C. Gaton, who has retired. Woodrow Brixius, formerly application engineer in the company's West Allis works centrifugal pump department, has been named assistant to Mr. Murdock, and Paul B. Hugenberg has been appointed application engineer in charge of sales and orders.

With headquarters at York, Pa., S. J. Woodworth has been appointed sales manager of the Wright Hoist division of American Chain & Cable Co. Inc. He has been with the division for over twenty-five years and has had wide experience with hoisting applications and materials handling problems.

Election of Raymond Z. Oswald as vice president in charge of replacement sales of the Cleveland Graphite Bronze Co. was announced recently. He has been in the automobile parts sales field for twenty-four years and was president of Monmouth Products Co. when that company was purchased several months ago by Cleveland Graphite Bronze. Monmouth business is now conducted as the Monmouth Products Division of the Cleveland Graphite Bronze Co. Gilbert M. Salzman is manager of the division; James E. Bradley is sales manager; and Albert M. Currier Jr. is assistant sales manager.

Spencer R. Griffiths has been appointed assistant sales manager of Unistrut Products Co., Chicago. He was formerly associated with Joseph T. Ryerson and Son Inc., in charge of stainless steel sales in the Midwest.

Newly elected vice president and manager, chain and transmission division of Chain Belt Co., William J. Sparling has been with the company since 1928. Until 1934 he was in charge of the metallurgical laboratory, then was appointed assistant to the chief engineer of the chain and transmission division, a position which he held until he was made assistant works manager. Mr. Sparling has served as works manager for the past four years. E. P. Meyer succeeds Mr. Sparling as works manager, having previously held the position of assistant works manager.

Belfield Valve division of Minneapolis-Honeywell Regulator Co. is adding to its field sales staff in a new and expanded sales and manufacturing program. Those assigned to full time on regional valve sales are: Russell A. Schlegel for the eastern region, with headquarters in New York; George Brown for the central region, with headquarters in Cleveland; Robert Scott in the midwest

## 2 MICRO Precision Switches... 1. MICRO BAFI-2RN2 precision switch with adjustable roller arm actuator. MICHGIESWITCH

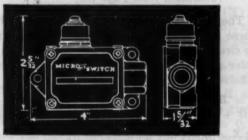
## **Combining High Electrical Rating** with High Inrush Capacity

These two MICRO precision switches offer the design engineer the answer to applications which call for a steady state current rating of 20 amperes and an inrush capacity of 75 amperes at voltages up to 460 volts a-c.

Available with both plunger and adjustable roller arm actuators, these switches are sealed in rugged die cast aluminum housings to protect against mechanical damage or shock. Overtravel mechanism is built into the metal housing. Ample wiring space is provided in the housing. Side facing terminals on the enclosed basic switch simplify wiring.

Underwriters' Laboratories list these two switches for 3/4 H.P., 115 volts a-c; 11/2 H.P., 230 volts a-c; 20 amperes, 125, 250 or 460 volts a-c; tungsten lamp, 10 amperes, 125 volts, a-c.

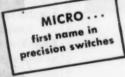
These two switches are typical of MICRO'S continual effort to develop new precision switches to meet every type of design requirement. They are but two of more than 3900 varieties of MICRO precision switches. Whatever your design problem, if it involves the use of precision snap-action switches, consult MICRO SWITCH engineering service direct or contact any of the offices listed. It may save you time and money.



2. MICRO BAFI-2RN precision switch with plunger

right and left hand designs.

actuator. Both switches are available in both





## **New MICRO Improved Adjustable Roller Arm Actuator**





## MATCHED for thermal characteristics

Switch the temperature back and forth from 340 to -55°C, over and over, and still you won't affect the stability of Ward Leonard Vitrohm Resistors.

Reason is: Ward Leonard, making all components\*, can control thermal characteristics so as to survive the greatest temperature variations.

Write for Vitrohm Resistor Catalog, Ward Leonard Electric Co., 58 South Street, Mount Vernon, N. Y. Offices in principal cities of U. S. and Canada.

WARD LEONARD
ELECTRIC COMPANY
Result-Engineered Controls



and northwest regions, with headquarters in Chicago; and William Clements in the Pacific, north coast and mountain regions, with headquarters in Los Angeles. All of these new appointees were formerly members of the field sales staff of the Brown Instruments division of the Honeywell organization.

In an announcement made recently, Marlowe Young of Soldering Specialties, 19 Chatham Rd., Summit, N. J., announced new regional representatives to handle sales of all Soldering Specialties products. Newly appointed representatives are: Harry Gerber, Gerber Sales Co., 739 Boylston St., Boston, Mass., covering the New England area; Harry C. Stockfleth, 10 Lake Rd., Chatham, N. J., whose territory is the New York metropolitan area; Harold F. Anderson 960 Harper Ave., Detroit, Mich., covering the Michigan area; and Arthur J. Ellis, Arthur J. Ellis Co., 1607 West Harvard St., Chicago 26, Ill., the representative in Illinois, Indiana, Wisconsin and Iowa.

The appointment of Walter Johnson as sales manager has been announced by the George K. Garrett Co. Mr. Johnson has had extensive experience in the metal industry, having been with leading steel companies on the West Coast for many years. He came to the Garrett Co. in 1941 and since then has held various positions working in co-operation with sales, production and procurement divisions.

### Relay Circuit Analysis

(Continued from Page 139)

as f(X). Then f(1) = Y and f(0) = Y + 1 = Y'. Putting these results into the circuit of Fig. 4, there results the circuit of Fig. 2.

Consider also Equation 10 as f(X). Then by letting X = 1

$$f(1) = BC + ABC + AD + ABD + ACD + BCD + AC + BD + ABCD \dots (14)$$

By letting X = 0

$$f(0) = AC + BD + ABCD \dots (15)$$

Now expanding each of these about, say, switch A: For A = 1, Equation 14 becomes

$$g(1) = BC + BC + D + BD + CD + BCD + C + BD + BCD = C + D + CD \dots (16)$$

and for A = 0, Equation 14 becomes

$$g(0) = BC + BCD + BD = B(C + D + CD)$$

for A = 1, Equation 15 becomes

$$h(1) = C + BD + BCD = C + BD + C(BD)$$
(18)

and for A = 0, Equation 15 becomes

$$h(0) = BD \qquad (19)$$

The general form of the circuit for the expansion about two switches, as illustrated in the foregoing, is given in Fig. 5.

By comparison with definitions 3 and 4 it can be seen that g(1) is C and D in parallel, that g(0) is

B in series with C and D in parallel, that h(1) is C in parallel with B and D in series and that h(0) is B in series with D. Putting these values into Fig. 5 a circuit can be derived whose openness and closure is identical with the bridge circuit of Fig. 3.

By successive expansion as begun already for X and A, it can be seen, Fig. 6, that any circuit having N switches can be expressed as an equivalent circuit having at most S switches where

$$S = 2 + 4 + 8 + 16 + ... + 2^n = 2^{n+1} - 2$$
 .....(20)

or by using three-way switches for pairs of complementary switches, any circuit can be expressed by using not more than  $2_n-1$  three-way switches. In general, of course, all the possible switches will not be needed to express an equivalent circuit.

CIRCUIT SIMPLIFICATIONS: It is obvious that, if X factors out of a formula, the circuit can be expressed as the switch X in series with the circuit represented by the factor by which X is multiplied. This fact is expressed in the following theorem:

Theorem 3: If f(0) = 0, then f(X) = Xf(1) and the circuit can be expressed by switch X in series with f(1)

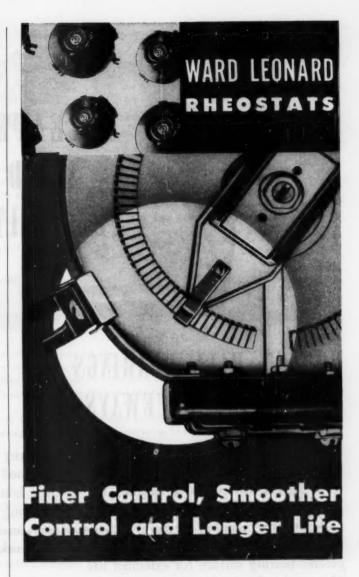
The first part of Theorem 4 follows from Theorem 1, and the second conclusion of Theorem 4 is a consequence of definition 3. In a like manner it is possible to state a relationship by which the entire circuit can be expressed as a circuit in parallel with switch X, viz:

Theorem 4: If f(1) = 1, then f(X) = X + (X+1) f(0) = X + f(0) + Xf(0), and the circuit can be expressed by switch X in parallel with f(0)

To illustrate Theorem 4, consider a circuit made up of several positions of switches A and B, as given in Fig. 7. For A = 1, it is seen that the circuit would be closed, so that f(1) = 1. For A = 0, it is seen that the circuit depends on the condition of the lowest B switch, so that f(0) = B. Thus Theorem 4 states that the circuit is equivalent to A in parallel with B.

CONCLUSION: The foregoing is admittedly a mere beginning in the analysis of relay circuits by means of odd-even algebra. The primary interest has been in determining whether an entire circuit is open or closed. Table 1 illustrates circuits using two relays, showing the condition of the circuit for various combinations of relay position. These conditions are established by the use of the formulas included in the table.

Other applications of odd-even algebra appear possible. The system can be extended to symbolic logic by identifying odd numbers with true propositions, even numbers with false propositions, multiplication with the "and" function and, finally, identifying "or" with the X+Y+XY relationship defined in this article for two switches in parallel. The study of the foregoing theory has been found useful for solving circuit problems.



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The greater number of solid rectangular contacts gives Ward Leonard multi-step rheostats finer control with smoother contact arm operation—and with all the advantages of the Vitrohm construction.

The solid metal contacts, connected to the resistance element by a patented Ward Leonard method and embedded in vitreous enamel—assures a mechanically and electrically perfect joint for long and constant service.

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## GREATER LOAD CAPACITY

## HOOVER BALL BEARINGS with HONED RACEWAYS

Hoover Ball Bearings provide greater load capacity — longer life . . . plus values made possible by honed raceways, an exclusive Hoover feature. For Hoover honing goes a step beyond grinding and polishing in producing finer, smoother raceway surfaces. Closer race curvatures furnish a wider area of ball support for greater work . . . greater bearing surface for extended life.

Thousands of manufacturers of quality products have gained a competitive advantage in their markets by using Hoover Ball Bearings with honed raceways. Upon request, a copy of the the Hoover Engineering Manual will be sent to engineering and purchasing executives.



The Aristocrat of Bearings

HOOVER BALL AND BEARING CO., ANN ARBOR, MICH.

AMERICA'S ONLY



BALL BEARING

WITH HONED RACEWAYS

## SALES

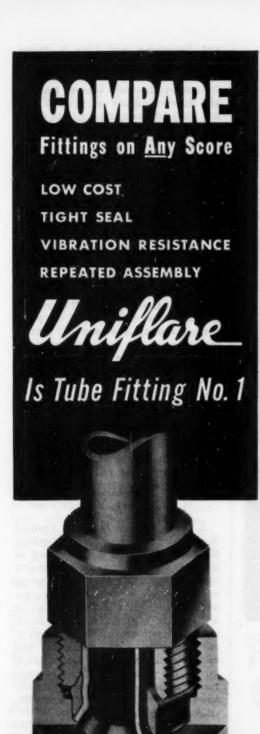
Manufacturers and fabricatics for industry, Synthane Corp. of Oaks, Pa. has moved its Chicago sales offices to larger quarters and a more convenient location at Morton Grove, Ill., in the growing industrial area northwest of Chicago. The company has leased and equipped a modern building, combining stock warerooms and offices. Ellis W. Croisant is Chicago district sales manager.

Commercial Filters Corp. of Boston, Mass., manufacturers of filters and cartridges for the microscopic filtration of all industrial and commercial fluids, has opened a Midwestern sales office at 603 West Washington Blvd., Chicago, Ill. The new office will be under the direction of Walter H. Magee.

Two new distributors for the state of California have been appointed by the Flexitallic Gasket Co. of Camden, N. J. Power Engineering and Equipment Co. Inc., 131 North Marine Ave., Wilmington, Calif., will serve southern California, and the northern section of the state will be served by Transmission Engineering Co., 53 Stevenson St., San Francisco 5, Calif. The Flexitallic Gasket Co. has also appointed Tube Engineering and Service Co. Ltd., 2052 St. Catherine St., W., Montreal, Canada, as distributor for all Canadian provinces east of Manitoba.

The name of Dohner & Lippincott, industry designers, has been changed to Lippincott & Margulies. The offices of the company are located at 500 Fifth Ave., New York 18, N. Y.

A partnership has been formed for the purpose of helping builders of machinery, equipment and technical products in their management, distribution and sales problems. The partnership combines the experience and facilities of Bernard Lester, sales management engineer and formerly manager resale department of Westinghouse Electric Corp.; Frank W. Hankins, industrial sales and marketing counsellor of Hankins-Borie





Save on production costs. Scavill's UNI-FLARE is two-piece fitting that is selfflaring. No preliminary flaring operation-no flaring tools needed-no tube cracking that sometimes accompanies flaring. And you can use lighter, less costly tubing.

Assure tighter seal. Scavill's UNIFLARE makes the recommended 37 degree flare without weakening the tube. Special brass alloy permits more tightening.



Provide greater strength. Scovill's UNIFLARE has triple the strength of a compression fitting. Exhaustive pressure tests prove that the tube will burst (but not at the joint) before the UNIFLARE fitting will leak. The assembly illustrated above was subjected to such a test.

Allow for frequent disassembly. Scavill's UNIFLARE can be taken apart and reassembled many times without weakening the seal.

UNIFLARE is available in a complete range of sizes for tubing 1/4 in. through 1 in. O. D. and in all standard shapes. Fully tested and approved by the Underwriters' Laboratories, Inc.



You can safely specify UNIFLARE for refrigeration, etc. The inverted flare and taper of nut thread toward wrench end help keep out condensate.

### **HOW DOES IT WORK?**

One turn of the nut shears off the thrust collar, clamping it onto the tube; further tightening forces the tube over the flaring cone and makes the seal. No flaring tools needed . . . no separate flaring operation . . . no cracked tubing to worry about.

Investigate UNIFLARE for oil, air, water or hydraulic lines. Write on company letterhead for a working sample. Address Screw Machine Products Division, SCOVILL MANUFACTURING COMPANY, 50 Mill Street, Waterbury 91, Conn.



Uniflare The Complete, Self-flaring Tube Fitting



## Why Experiment? . . . Specify Miller "Time Tested and Proven" Cylinders—And Be SURE!

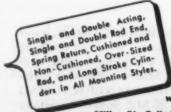
All Miller Standard High Pressure Hydraulic Cylinders met both the mandatory and recommended practices of the "Standards" years ago.

Some "Standards" specifications, such as dirt protectors, scratch-resistant piston rods, etc., are required only under severe conditions. All Miller Standard High Pressure Hydraulic Cylinders met these requirements years ago.

The desire for elimination of manual rod seal adjustment is strongly voiced at all hydraulic industry conferences. The "time tested and proven" Miller Patented Rod Seal is self-adjusting and wear compensating . . . requires no manual adjustment.

### Complete Line

- AIR CYLINDERS 11/5" to 20" Bores
- \* LOW PRESSURE HYDRAULIC CYLINDERS 11/2" to 14" Boros
- HIGH PRESSURE HYDRAULIC CYLINDERS 1½" to 12" Bares



Miller Air Cylinder Bulletin A-105 and Miller Hydraulic Cylinder Bulletin H-104

### MILLER MOTOR COMPANY

4025 N. KEDZIE AVE. . CHICAGO 18, ILLINOIS



and Associates; and John A. Silver, former executive vice president and director of F. J. Stokes Machine Co. Offices of the new Lester, Hankins and Silver company are at 1605 Race St., Philadelphia 3, Pa. and 140 Cedar St., New York 6, N. Y.

The Holden Co. Ltd. of Montreal has been appointed exclusive Canadian sales agent for seamless flexible metal hose manufactured by the Eclipse-Pioneer division of Bendix Aviation Corp. The appointment of the Canadian agency is expected to effect economies for customers in Canada and to expedite routine sales and service functions. In addition, factory-trained experts will be readily available for consultation on problems involving the use of flexible metal hose.

The Los Angeles branch office of the Rucker Co. has been moved to larger, more modern quarters at 1855 Industrial St., Los Angeles, Calif. This company is exclusive distributor for Denison, Dudco and McIntyre hydraulic fluid pumps, motors and valves, Modernair and Hanna cylinders and many other leading lines.

A new engineering and product design organization called Century Engineers Inc. has been formed in Burbank, Calif. Century Engineers offers companies lowered engineering costs through a pool of engineering talent, either on a full-time basis or for specific projects. Shop facilities, when needed, are available to work out manufacturing problems and carry engineering and design work up to the point of volume production. Offices of the new company are located at 204 North Parish St., Burbank, Calif.

Because of increasing demand for automatic parts handling equipment Kraus Design Inc., has moved to larger quarters at 950 Exchange St., Rochester 8, N. Y.

Two exclusive representatives for the company's air and hydraulic cylinders and special machinery have been appointed by the Hydro-Line Mfg. Co., Rockford, Ill. They are Austin-Hastings Co. Inc., 226 Binney St., Cambridge, Mass., covering all the New England states except Connecticut; and Hydro Pneumatics Inc., 95 Liberty St., New York, N. Y., with the territory of metropolitan New York and northern New Jersev.

## MEETINGS

### AND EXPOSITIONS

Dec. 19-21-

American Society of Agricultural Engineers. Winter meeting to be held at the Stevens Hotel, Chicago, Ill. Raymond Olney, P. O. Box 229. St. Joseph, Mich., is secretary.

#### Jan. 9-13-

Society of Automotive Engineers. Annual meeting and engineering display to be held at the Book-Cadillac Hotel, Detroit, Mich. John A. C. Warner, 29 West 39th St., New York 18, N. Y., is secretary and general manager.

#### Jan. 11-13-

Society of Plastics Engineers Inc. Annual technical conference to be held at the Hotel Carter, Cleveland, Ohio. Mrs. Bess R. Day, 409 Security Bank Bldg., Athens, Ohio, is executive secretary.

#### Jan. 16-19-

Plant Maintenance Show to be held in the Cleveland Auditorium, Cleveland, Ohio. Additional information may be obtained from Clapp & Poliak Inc. 341 Madison Ave., New York 17, N. Y.

#### Jan. 23-26-

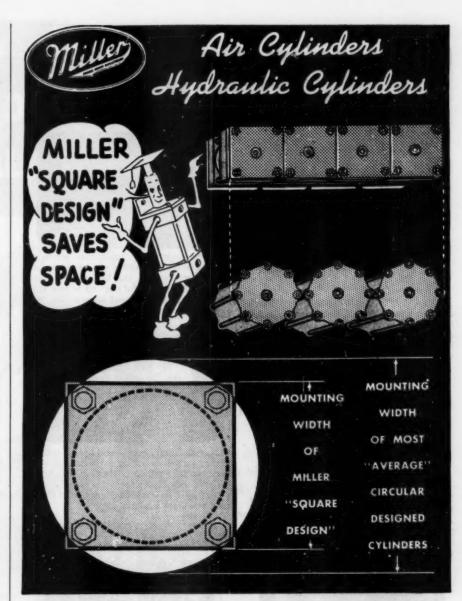
Institute of Aeronautical Sciences. 18th annual meeting to be held at the Hotel Astor, New York, N. Y. Robert R. Dexter, 2 East 64th St., New York 21, N. Y., is secretary.

### Jan. 23-27

American Society of Heating and Ventilating Engineers. Fifty-sixth annual meeting and the Southwest Air Conditioning Exposition to be held in Dallas, Texas. A. V. Hutchinson, 51 Madison Ave., New York 10, N. Y., is secretary of the society and Charles F. Roth, Grand Central Palace, New York 17, N. Y., is exposition manager.

### Feb. 12-16-

American Institute of Mining & Metallurgical Engineers. Annual meeting of the Iron and Steel Division, the Institute of Metals Division and the Extractive Metallurgy Division in connection with general meeting of AIME to be held at the Hotel Statler, New York, N. Y. Ernest Kirkendall, 29 West 39th St., New York 18, N. Y., is secretary.



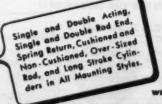
Other Outstanding Miller Standard Features . . .

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- DIRT WIPER SEALS. Keep out abrasive dirt.

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### Complete Line

- AIR CYLINDERS
   11/2" to 20" Bares
- LOW PRESSURE HYDRAULIC CYLINDERS 11/2" to 14" Bares
- HIGH PRESSURE HYDRAULIC CYLINDERS 1½" to 12" Bores



Miller Air Cylinder Bulletin A-105 and Miller Hydraulic Cylinder Bulletin H-104

MILLER MOTOR COMPANY

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 "HEAT... WHERE YOU WANT IT" is the name of a new General Electric sound slidefilm on industrial electric heaters. It covers dozens of cost-cutting opportunities for electric heat, as in the crank-case cleaner (above) where...



2...a built-in immersion heater was used to supply the hot oil needed to do the job right. Another place where electric heat had to make oil "keep moving" was in the feed lines of this fuel-storage tank (above). But the big opportunity for electric heat is in...



3...heating surfaces which, in turn, heat something else. Typical of the applications shown in the film is this sludge-drying fan (above) where electric heaters are clamped between the blade sections. A simple application, yet completely effective!



4. If you want to dry, bake, cure, warm, or ripen something, there's plenty of visual data on air heating, too. You can even see how it's done "on the run" as in this continuous air-heating tunnel (above). Or, possibly you'd like to . . .



5... melt a soft metal — and keep it melted, the way it's done in this automatic can-sold-ering machine (above). "Heat...Where You Want It" has all the facts you need. To convince you of its worthwhileness, we'd like to send you these 5 helpful...



6. APPLICATION BULLETINS—FREE! Fifty copies of each come with a complete film kit (35mm slidefilm, 33½ RPM record, bulletins—cost, only \$15). Once you've seen them, you'll want to see—and buy the complete program. MAIL THE COUPON TODAY!

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Feb. 27-Mar. 3-

American Society for Testing Materials. Spring meeting to be held at the Hotel William Penn, Pittsburgh, Pa. Robert J. Painter, 1916 Race St., Philadelphia 3, Pa., is assistant to the secretary.

Mar. 14-16\_

Society of Automotive Engineers. Passenger car, body and production meeting to be held at the Book-Cadillac Hotel, Detroit, Mich. John A. C. Warner, 29 West 39th St., New York 18, N. Y., is secretary and general manager.

Mar. 28-31-

Society of the Plastics Industry. Fourth national plastics exposition to be held at the Navy Pier, Chicago, Ill. William T. Cruse, 295 Madison Ave., New York 17, N. Y., is executive vice president.

Apr. 4-8\_

National Production Exposition sponsored by the Chicago Technical Societies Council will be held at the Stevens Hotel, Chicago, Ill. John C. Toohy, 176 W. Adams St., Chicago 3, Ill., is exhibit manager.

Apr. 10-14-

American Society of Tool Engineers. Industrial exposition to be held at Convention Hall, Philadelphia, Pa. Additional information may be obtained from John M. Cannon, Director of Public Relations, 10700 Puritas Ave., Detroit 26, Mich.

Apr. 17-19\_

Society of Automotive Engineers. Aeronautic meeting and aircraft engineering display to be held at the Statler Hotel, New York, N. Y. John A. C. Warner, 29 West 39th St., New York 18, N. Y., is secretary and general manager.

May 8-12\_

American Textile Machinery Exhibition to be held in Atlantic City Auditorium, Atlantic City, N. J., under the sponsorship of the National Association of Textile Machinery Manufacturers. E. Kent Swift, Whitinsville, Mass., is president.

June 11-15-

American Electroplaters' Society. 37th annual convention to be held at the Hotel Statler, Boston, Mass. The Fourth International Electrodeposition Conference in collaboration with the Electrodepositors' Technical Society of England will be held at the same time. Additional information may be obtained from American Electroplaters' Society, 47% York Rd., Jenkintown, Pa.

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### DESIGN ABSTRACTS

### High-Compression-Ratio Engine Tougher To Make

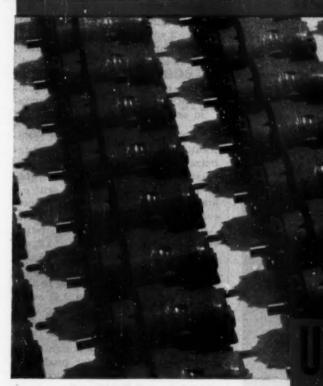
HIGH-SPEED engines capable of withstanding compression ratios of 10 to 1 impose many production problems. This type of engine inherently involves closer machining tolerances and more exacting manufacturing and inspection procedures.

Speculation has it that such engines will be shorter in overall length and height, of more sturdy construction, and will have a stroke-to-bore ratio of about one. These factors tend to facilitate machining. The main and connecting rod bearings will be larger to withstand the heavier loads. The main crankshaft and connecting rods probably will be forged to get the necessary rigidity characteristics.

Change-over to this high-compression type of engine will require the following changes, tightening up present production standards:

- Barring major advances in valve seat milling machinery, it probably will be necessary to lap all seats to the respective valves. Present machinery cannot mill or check valve seats to less than 0.004-in. total eccentricity with the valve stem guide
- Main and connecting rod bearings should be machined with a maximum taper and out-of-round of 0.0002 to 0.0003-in.—average present standard being 0.0003 to 0.0004in.
- 3. Connecting rods should be held within ±0.005-lb on each end, providing a total tolerance of 0.020-lb on the net weight. This will require special machinery which is under development, but not presently used in production by any manufacturer. Best tolerance obtainable today is about ±0.0075-lb
- 4. Pistons also will have to be machined to correspondingly low weight tolerances of ±0.004-lb. This tolerance should not impose the problem that the connecting rod limit does because we already have equipment able to hold this limit on a production basis
- 5. Weight of piston and connecting rod assembly will be held to the lowest amount commensurate with required strength, which means that the pistons probably will be made of aluminum alloy. Costs of

## GEARED POWER for multiplied Torque



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End bells can be removed for quick inspection of gears, bearings and oil reservoir without disturbing bearings



### 10 TO 10,000 RPM-1/4 TO 30 HP

Built-in gearing, protected from dust, dirt and drippings, is mounted within a pyramidal structure in the U. S. Syncrogear motor. Gears forever remain in proper alignment. The sealed oil reservoir provides perfect lubrication to all gears. Every casting is normalized, preventing inaccuracies of bearing settings. The motor windings are asbestos protected, to guard against carbonization. The centricast rotor is indestructible. Complete harmony in design insures strength without stress, extreme compactness and continuous quiet operation without over-heating.

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machining aluminum compare with those for machining cast-iron pistons, so the major price differential between the two types lies mainly in the higher cost of aluminum alloy

6. The engine assembly must be balanced within one-sixteenth of an ounce-inch to be satisfactory, which also creates production problems and requires development of new machinery. Present equipment is capable of balancing within one-eighth of an ounce-inch.

Such close weight limits on reciprocating parts are necessary to minimize the undesirable secondary unbalance condition at the higher speeds at which the future engine will operate. This unbalance cannot be corrected after the engine is assembled.

The project engineer can materially facilitate manufacturing if he will design the main bearings to tolerate a variation of 0.0015-in. in clearance without adverse effects. The production problems posed when it is necessary to maintain more limiting tolerances are not only complicated, but also costly.

Another factor is the design of the combustion chambers for production by casting or machining. A chamber cannot be cast within volume limits of less than ±0.1-cu in. on a production basis, due to inherent variations in casting which result from factors like warpage, sands, cupola mixes, and permeability of molds. Very likely a variation of 0.2-cu in. could be tolerated at compression ratios less than 8 to 1; it would be more economical to use cast chambers in this range.

#### Machined Chamber Will Be Needed

As ratios are increased, it will be necessary to hold variations to progressively smaller increments. At such time the machined chamber will be required. Machining will be more economical than trying to hold a cast chamber by grit blasting or other methods in production.

In most cases, changes in manufacturing methods will result in an abrupt departure from past procedures and will entail considerable equipment and tooling expenditures. If the present engine manufactured by the company—such as a valve-inhead V-8 or straight six—is adaptable to high compression, some of the existing equipment might be usable to manufacture the new engine. But in most cases the equipment will be obsolete

This stems directly from development work on continuous or process type machinery. The advantages pro-

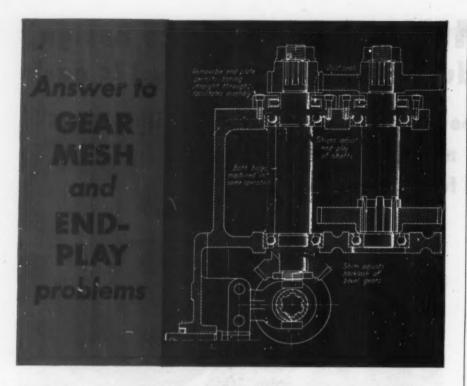
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die pressed of powdered iron or bronze to within .0005" eliminate costly machining time oil impregnated for self lubrication



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Laminated shims can stop the expensive process of assembly, testing, disassembly, machining a few thousandths, reassembly, retesting and so on for many costly hours.

## DO WHAT THIS LEADING MACHINE TOOL MANUFACTURER DID...

In the milling machine above, bores for inner and outer bearings are machined to one diameter in one operation. Removable end-plate permits boring straight through outer bearing housing and makes assembly of shaft, bearing and dust seal much simpler. SAVING: hours of machining and assembly time.

## AND SIMPLIFY YOUR ADJUSTMENTS BY USING LAMINATED SHIMS...

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vided by this type of machining are exemplified mainly by reductions in labor costs and elimination of scrap due to inherent human errors. But when new equipment has to be acquired on a large scale, or where expense of reworking the old equipment is prohibitive, this new type of machinery satisfies most requirements.

Major disadvantage of this machinery rests in the fact that it lends itself to specialization and is not easily adaptable to design alterations once installed. This factor should be kept in mind when procuring equipment to avoid premature obsolescence.

Due to the high cost of such an extensive retooling program and considering the petroleum industry's problems in increasing octane ratings of fuels, I believe we can expect any manufacturer who has a valve-inhead engine at present to retain that engine, with slight modifications, for at least another year or two.

This time might also serve to realize a readjustment in material and equipment costs, which would act in the automobile manufacturer's favor. From a paper by H. Richard O'Hara, Jr., Buick Motor Division, General Motors Corporation, presented at the recent SAE Detroit Section meeting.

### **Needed—Specific Specifications**

DETERMINATION of the size and variation in size of any feature of a product alone, whether by conventional inspection methods or by means of statistical control, means nothing. If that part or feature of a part has a definite duty to perform, then its size must be such that its full duty will be adequately performed. The term "quality" by itself and in the sense used in quality control is meaningless. A product is not simply good, it must be good for a certain use, and the term quality apart from the use in view means nothing. Good quality means good for a certain use.

The dimensional condition necessary to meet this quality may, at times, need to be determined by trial or be established from actual experience. Once it is determined, or even assumed for the purpose of making some definite start, it must be specified in unmistakable and definite terms. It must be so specified that anyone "skilled in the art" can, by means of definite measurement or comparison, demonstrate definitely that either it does meet the specifications or it does not meet them. There must be no foggy region of uncertainty. Whether or not the dimensional specifications are the



H. W. BUTTERWORTH & SONS CO., Philadelphia, are leading builders of a large line of textile industry equipment. Castings for their machinery are produced in their own Meehanite foundry. Their designers and engineers build in quality by utilizing from the beginning the better engineering characteristics available in the various types of Meehanite castings produced.

The photograph shows a Butterworth Compartment Washer and also indicates the variety of Meehanite castings used in every compartment.

To the equipment they provide higher vibration absorption properties; better strength characteristics; freedom from fear of hidden defects which might result in failure; in all,—a combination of those characteristics so important to builders of all types of equipment.

Write for Bulletin No. 32 entitled "Meehanite Quality Control Assures Uniform Dependability" to any of the foundries listed.

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Crawford & Deherty Foundry Co	Portland, Oregon
Farrel-Birmingham Co., inc.	Ansonia, Connecticut
Florence Pipe Foundry & Machine Co	Florence, New Jersey

Fullen Foundry & Machine Co., Inc.	Cleveland, Ohio
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The Henry Perkins Co.	Bridgewater, Massachusetts

	Ross-Meekan Foundries	Chaffansega, Tennesses
	Shenange-Penn Held Co	
1	Sonith Industries, Inc.	Indianapolis, Ind.
	Standard Foundry Co.	
1	The Stearns-Roger Manufacturing Co	Denver, Colorada
1	Traylor Engineering & Mfg. Co.	Alientewn, Pennsylvania
	Valley Iron Works, Inc.	St. Paul, Minnesota
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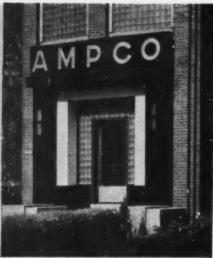
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AMPCO METAL, INC.

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correct ones, there must be no uncertainty about the actual dimensional conditions that are specified. If these specifications themselves are incorrect, they can be corrected. If the method or language used to specify them is ambiguous and indefinite, then no correction is possible until the language has been perfected.

### Present Language Incomplete

The present language of drawings as it affects dimensions and tolerances is incomplete, ambiguous in many respects, and dumb in regard to many very important dimensional conditions. Whether words or symbols are used, a precise language with precise definitions is the first requirement of a clear and definite specification.

It must be recognized that many different kinds of dimensional information are needed on drawings. In this respect, dimensions may be classified into the following types:

- Limiting dimensions or dimensions and tolerances which must be rigorously maintained.
- Constructional dimensions which may be seldom, if ever, measured directly in production.
- Calculated dimensions which may represent some basic starting point but which are never measured directly in production.

Some notation should be adopted to identify these different types of dimensions. The limiting dimensions themselves serve different purposes and must be considered under different categories. Effective methods for their control require different treatments. But first of all, it is necessary to reach a definite agreement as to the fundamental meaning of the limiting dimensions on the drawing. For this, in the writer's opinion after over forty years' contact with this problem, the only logical and defensible interpretation is that the limiting dimensions, on the part drawing, represent the requirements of the inspection gages. In other words, it must be possible to translate every limiting dimension into a definite form of measurement or definite design and size of an inspection gage. Hence these dimensions specify specific tests with specific gages and all parts of the product that meet these tests must be adequate dimensionally to meet the service or use requirement. This is no easy task.

Limiting dimensions are required

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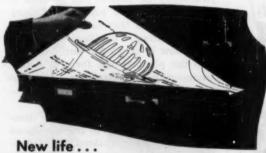
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GAST ROTARY DESIGN GIVES BOTH VACUUM AND PRESSURE FOR FEEDING APPLICATIONS



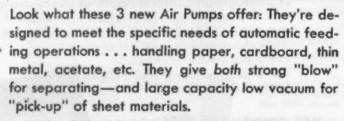
Model 3040, new SINGLE CHAMBER PUMP—19 to 24 c.f.m. Pressure up to 10 p.s.i.—vacuum 15" and over.



Model 10 x 1040, small DUAL CHAMBER PUMP—9 c.f.m. from each chamber. Vacuum to 20", pressure to 15 p.s.i.



Model 11 x 1740, large DUAL CHAMBER PUMP—14 c.f.m. (to 10 p.s.i.) from pressure chamber; 9 c.f.m. (to 15") from vacuum chamber.



With all the inherent advantages of Gast Rotary Design, they run quietly, producing large volume per horsepower at comparatively low speeds. They're trim in appearance and unusually compact. V-belt drives simplify installation and make speed control easy.

If you're building machines that can be fed with suction fingers—you'll want full details. Remember —"Air may be your Answer!"



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DETAILS ON
3 NEW AIR
PUMPS—ALSO
"APPLICATION
IDEAS" BOOK



GASTROTTRRY GAST

(TO ONE N.P.) (TO 30 LBS.) (TO 28 INCHES)
GAST MANUFACTURING CORP., 107 Hinkley St., Benton Hurbor, Mich.

to specify the following conditions: (a) Conditions of size; (b) conditions of form: (c) conditions of operation or functioning. The method of specifying the permissible variation or tolerance must be different on each of these conditions. Conditions of form or conditions of position treated in the same manner as conditions of size lead to chaos. Gages of size, gages of form, gages of position, and functional gages all have quite different characteristics. The present practice takes care of but little more than conditions of size, with a slight approach to conditions of form. Conditions of position have been ignored almost completely. We need a vocabulary and dictionary which will cover all of the different dimensional conditions, From a paper by Earle Buckingham, professor of mechanical engineering, Massachusetts Institute of Technology, presented at third annual convention of American Society for Quality Control.

## Trouble Shooting with Quality Control

S TATISTICAL quality control in a job shop producing upward of a thousand different products for equally as many customers, might well be impossible were the common usages applied. The problems of introducing and using control charts, frequency distributions, and sampling tables into the score of mechanical manufacturing, processing and assembly operations of a conservative New England plant with three generations of "know-how" can be readily imagined. However, Dr. Shewhart's philosophy of control can be and is put to use in the solution of many daily problems that arise in contract manufacturing. In these cases the know-how is quantified and fed back into the plant in the form of better engineering specifications, and relayed to the customer for more complete service.

Actual cases will be used to illustrate the end results of investigations that have brought about the reduction of scrap and rework, the elimination of 100 per cent inspection, and the forecasting of machine tolerances and tool wear.

The first product investigated statistically in the plant was a throttle rod linkage in a recently retooled popular priced car. The company had produced similar rods for about twenty years without too much difficulty and a minimum of written specifications, but when this product went into production, thirty to forty per cent of the assemblies were found to be defective. Seven departments contributed to this scrap and



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### RADIAL BALL BEARINGS

Wherever shafts bend or deflect beyond the norm-where it is impossible to machine the housings in line, or when housings are mounted on separate structures and perfect alignment is impossible-Federal Self-Aligning Double Row Radial Ball Bearings meet the need for correcting such misalignment.

These versatile bearings are engineered so that the balls, spacer and inner ring always rotate freely within the spherical outer race at a considerable angle on either side of normal without binding or additional strain on the bearing parts. As a result, they are quiet-running, smooth-aligning and durable -solve problems which cannot be handled by ordinary radial bearings.

Federal Self-Aligning Double Row Radial Ball Bearings are made in light, extra-light, medium and heavy series; in regular and wide types for any load requirement; and in adapter and wide inner ring types for securing at any point along a plain or shoulderless shaft.

They're all described in our catalog "K," which covers the complete Federal line...every type and size, shielded and sealed...for every anti-friction need. (A few of the many types are shown here.) You'll also find ball bearing selection charts to help you compute bearing loads, determine capacities at every speed, and select the type and size ball bearing best suited to your application. Write today for your copy of this 260-page catalog.

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rework, each of which was certain beyond a doubt that the other six were totally at fault.

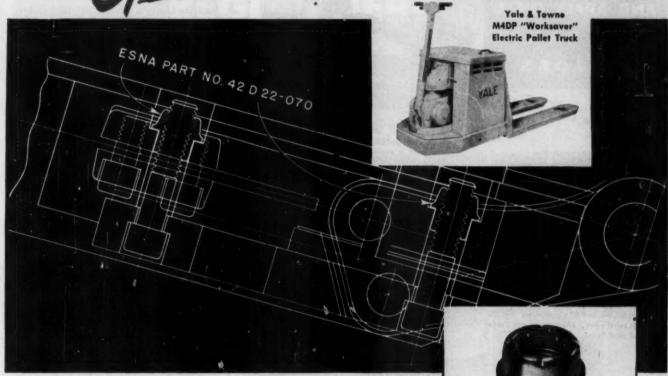
In order to investigate the causes, the product was analyzed by means of frequency distributions of random samples at each stage of manufacture. Thus the quality level of each department was evaluated and a basis for remedial action established. Next, a lot was put through normal routine using control chart techniques to check the process capabilities with the print tolerances and to ascertain whether a state of control existed. This information was accumulated and issued to the plant in the form of new specifications, considering the product as a whole, and soon after the product was produced at one-half of one per cent defective. The results have been applied to similar products and have provided an entering wedge for statistical thinking in the plant.

### **Sorting Operation Eliminated**

The second case illustrates how an expensive 100 per cent sorting operation was eliminated by a study of the processes and a shift in their order. In the manufacture of compression springs, the least accurate stage of the process is the first operation; that of the spring coiler. To reduce variations in length or load, it is necessary to grind, set and test springs in that order. The set and test operation is a combined one and precedent had established it as the least expensive method. However, in the face of competitive bidding it was necessary to reduce the cost by the amount of the inspection operation and the quantity rejected. To quickly test whether this was possible, a coiler was set up to produce the maximum variation in length and load for a hundred samples. Fifty were processed through the time-tested way and about ten per cent were found to be over and under specification. The other fifty were set to the compressed height before grinding and the length variation was reduced about 25 per cent. When this lot was ground, the load variation distributed itself well within the specifications. The setting operation was an inexpensive one compared to testing and its cost was borne by the elimination of rejects.

The last case was a simple screw machine brass bushing with tolerances to spare. A test was running to determine the weight per thousand pieces when it was found that the length varied only 20 per cent of the tolerance and always on the high side. Because it was a small piece the total tolerance mounted to about 10 per cent of the material. Needless

# Self Locking Nuts FOR COST-CUTTING PRE-ASSEMBLY METHODS



# -The Red Elastic Collar protects inaccessible bolted fastenings from failures due to VIBRATION!

After testing many types of fastenings Yale & Towne selected ESNA spline nuts as the solution for the blind mountings on the front and rear assemblies of the M4DP "Worksaver" Electric Pallet Truck featured in this ad. Loose bolts at these inaccessible locations meant loss of adjustment and mechanical wear. Their research proved that self-locking connections at these application points provided protection against unnecessary down time . . . added assurance against service calls and repairs.

This is a typical example of the growing industrial acceptance gained by ESNA spline nuts... especially designed for easy driving into soft gray iron, magnesium or aluminum

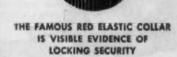
castings. By means of this simple installation the casting is given a threaded member; a tough drilling operation is speeded up because the drill is allowed to run through the casting . . . costly tapping operations are eliminated. The self-locking collar does away with expensive cap screw lock wiring and fully protects inaccessible or blind mountings from operating failures.

In addition, if dis-assembly is required, ESNA spline nuts remain securely positioned for quick reinstallation and the famous Red Elastic Collar provides adequate locking torque for repeated re-use.

This is only one of many types of standard Elastic Stop Nuts available for special industrial fastening problems.

HERE'S A CHALLENGE: Send us complete details of your toughest bolted trouble spot. We'll supply test nuts—FREE, in experimen-

tal quantities. Write: Elastic Stop Nut Corporation of America, Union, N. J. Representatives and Agents are located in many principal cities.



Threadless and permanently elastic, it provides these 4 outstanding features:

- Protects against nuts loosening due
  to VIBRATION
- 2. Keeps locking threads CORRO-SION FREE
- 3. Provides for accurate BOLT LOADING
- 4. Seals against LIQUID LEAKAGE along the bolt threads

**ELASTIC STOP NUTS** 



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VER 450 TYPES AND SIZES IMMEDIATELY AVAILABLE PROM STOCK

# Series "K" Roper Pumps

EASY TO INSTALL AND APPLY ON A WIDERANGE JOBS

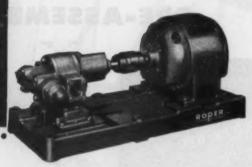




Fig. 1K Pump Head with packed box, built in 5, 10, 15, 20, 30, 40, and 50 g.p.m. sizes. Fig. 2K has built-in relief valve. Mechanical seal available on all models.

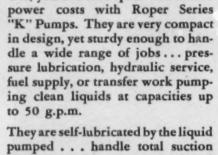


Fig. 26K Motor-Driven Pump Unit with built-in relief valve head is available in all sizes. Also Fig. 25K with head less relief valve. Includes bedplate and coupling to suit standard motor frames. Furnished with

Yes, you can save space and reduce

coupling to suit standa or without motor,

lifts up to 25 feet . . . come equipped with mechanical seal or packed box ... with or without relief valve.

Venturi suction and discharge principle provides properly proportioned distribution of liquid pumped, thereby minimizing energy loss through turbulence, cavitation, or friction.

Series "K" pumps are available in 34 to 50 g.p.m. sizes, pressures to 150 p.s.i.



Fig. 17K Pump Head with mechanical seal. Capacities 3/4,11/2, and 3 g.p.m. sizes. Packed box is available. Fig. 18 K is equipped with built-in relief valve.

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to state, the limits were changed to the low side with a resultant saving in raw material. The reason given for the large tolerances was the high speed of production, which made for high tool wear. It was found that this was caused by incorrect setting and the need for machine tending was reduced.

There are many other specific applications of statistical quality control in the job shop, but the underlying motive for these investigations is the quantification of the existing know-how and the successful forecasting of new techniques. From a paper by E. E. Schiesel, Stevens Institute of Technology, presented at third annual convention of American Society for Quality Control.

#### **How To Boost Quality**

WE are emerging from a national quality spree. Since 1941, though plagued with materials shortages, labor shortages and equipment shortages, we have done a superb production job. But attached to much of that production was the visible tag of high price and the invisible label of poor quality.

Our shortages are now behind us, but the habits they generated are still with us. We relaxed standards, used ersatz materials and put up subnormal machine maintenance. We handled vendors with kid gloves while kicking our inspectors and customers all over the place. We sanctioned the doing of these things, year after year. To sanction them we authorized changes in specifications, practices, routines. For the most part these changes are still on the books. For the most part these practices are still the prevailing practice. For the most part the habits of personnel are still those of low quality and high cost.

From my observation, there are three general methods being tried by executives to get back to high quality and low cost. Two of these methods are weak extremes. At one extreme is an eloquent appeal to personnel, pointing out that competition is here, that costs must come down, that quality must go up. This appeal, however eloquent, is bound to fail because it is not founded on a planned program for action. At the other extreme is a bits-and-pieces effort of getting after really bad instances as they rear their ugly heads. This effort is likewise doomed to failure because it just pecks away at the problem instead of going after basic causes with an organized plan

The third and successful method is to prepare a comprehensive set of

of action.

# MUCH ELECTRICAL MANUFACTURING MAGIC BEGINS HERE

One of the best known manufacturers of air circuit breakers in the country is the I-T-E Circuit Breaker Company, located at 19th and Hamilton Streets in Philadelphia. From its inception the company has displayed unusual receptiveness to new ideas, whether from within or without; hence it has done its share of pioneering, and perhaps more. Revere is proud to play a part in its progress, through close collaboration with I-T-E engineers, production men, and the purchasing department. The extensive use of Revere Extruded Shapes is but one result of our mutual attack upon I-T-E problems, which the company is good enough to say has saved a great deal of money, as well as made possible a better product... Perhaps similar results would be obtained if you gave us the opportunity to place our knowledge as well as our metals at your disposal. Why not inquire?



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This is but a part of the I-T-E Stock of Revere Extruded Shapes in copper, brass, manganese bronze, and aluminum. I-T-E is a great advocate of extruded shapes, from long experience finding them markedly superior, in uniformity, strength, and economy due to the fact that a great deal of machining is avoided.









(Left) I-T-E Contact Block made from an extruded shape. This was formerly extruded in electrolytic copper; changing to Revere Free-Cutting Copper resulted in a saving of 30% in machining time. (Right) I-T-E "K" Breaker, Main Contact Assembly in open position. This is an especially interesting assembly, since it shows no less than eight extruded shapes in copper and bronze. Use of these shapes makes the assembly more compact, stronger, lighter, and considerably more economical to produce. The contacts are silver alloy, and the unit is silver plated... In addition to supplying I-T-E with extruded shapes, and strip, Revere furnishes rolls, bar, rod, sheets, in a wide range of non-ferrous alloys, and seamless brass tube.

(Left) Main movable Contacts and Flexible Connectors in an I-T-E "K" Type Circuit Breaker. The two contacts are made from Revere Extruded Shapes. Revere and I-T-E collaborated closely on the specifications for the thin-gauge copper strip for the pigtails, working out the correct gauge and temper to avoid notch effects and cracking of the connection at the braze. (Right) Main Separable Contacts from an I-T-E Type "LG" Circuit Breaker. These are stamped from Revere Copper Strip with the temper specially controlled to eliminate a de-burring operation previously found necessary to obtain edge surface suitable for electrical contacts. (Inset) Back view of "K" type Breaker showing a similar type of contact.

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objectives, to assign to everyone in the company a part he can play, to provide a scoreboard to measure the progress of the plan, and to supply the necessary stimuli for achieving the objectives. The essential elements of such a plan are as follows:

1. Prove to each employee that he has a personal stake in the company's quality reputation. This can be done by an internal advertising campaign-posters, slogan contests, reports from customers, articles in the house organs, moving pictures, anything appropriate for showing a clear connection between employees' personal interests and the quality of the final product.

2. Compute the "gold in the mine" to demonstrate that better quality costs less. Find out what the cost is which arises from presence of defects\_the scrap, reworks, extra operations, discounts on seconds, service charges on guarantees, cost of sorting product when sampling might do, and so on. As often as not, half of this cost can be eliminated by a thorough program of modern prevention. Reduction in cost can finance the entire program of quality improvements with room to spare. The potential improvement is an index of how big a program to launch.

3. Show each employee how he can personally contribute to better quality. This means clear specifications of what is wanted. It requires clear instructions on how to run the processes. It requires adequate measurement or standards so that the employee can judge as he works whether he is doing the job right. Proper induction of new employees, good training, balanced incentive plans and good maintenance practice are part of this. Competitions and contests are in order to urge the employee to find new ways amid old surroundings to improve quality.

4. Set up a quality control engineering group. Shop supervisors and personnel can make many improvements. But many of the fundamental improvements require extensive factfinding, trials and experiments, and special analysis of data. Shop personnel have neither the time nor the training to take on these lengthy studies. The budget for the master plan should provide for one or more quality control engineers.

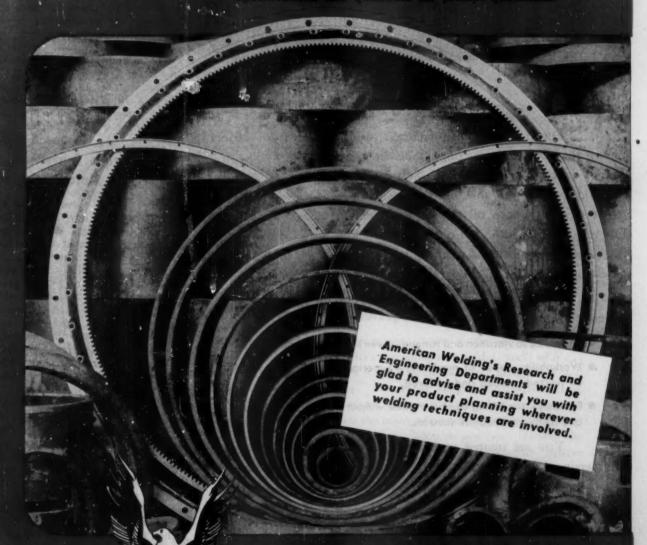
5. Provide for co-ordination and skilled counsel. A program like the foregoing demands participation by all major departments\_design, production, quality, sales, sales service, purchasing, methods, and others. Achievement of high quality at low cost is a teamwork job. A quality committee, with representation from

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Diesel engine manufacturers who use Superior "Monel" tubing for lubricator lines on cylinder liners, are taking a long stride toward dependable performance. Lubricator lines are small and vital; positioned as they are in a water jacket, they must withstand the corrosive effects of both oil and water. Selection of Superior "Monel" tubing—with its clean, non-pitting surface, its controlled ductility for ease of fabrication, its assured high strength—is one important way to eliminate tubing failure.

Consider—in addition—these important characteristics of Superior "Monel" tubing:

- Resistance to vibration and fatigue—even in varying temperatures.
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- Economy—the tubing can be worked without resorting to frequent and costly intermediate anneals.

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the principal departments, is an admirable coordinating device. Where the company has never before embarked on such a program it is well to secure advice from companies who have gone through such a program. An alternative is to engage, as an adviser, some qualified consultant in the field.

Clearly, top management has not the time nor the specialized skill to understand and follow such a program in detail. The detail must be left to those who do have the time and the specialized skills. But top management must: (a) Understand the need for doing it at all; (b) realize the size and character of the job to be done; (c) provide the budget, organization, personnel and stimuli needed; (d) arrange for co-ordination of the broad program; (e) set up to measure results; and (f) regulate the program based on results achieved. From a paper by Dr. J. M. Juran, dept. of administrative engrg., New York University, presented at third annual convention of American Society for Quality Control.

## Torque Converters Require Matched Engines

THE torque converter has opened up possible developments for future engine design, since engine and converter now must be matched to supplement each other.

The low-speed, low-torque, and low-efficiency parts of engine performance curves are made unusable by the converter. For this reason the engine designer now may concentrate on improving the upper ranges of engine performance without having to concern himself with the sometimes conflicting low-speed requirements.

Various means suggest themselves, including mechanically-driven or exhaust-driven superchargers. A mechanical supercharger drive making use of the speed differential across the converter seems possible by using a differential drive. This type of drive would provide engine supercharging in accordance with the vehicle's own torque demand rather than in accordance with engine speed.

With the advent of new prime mover types, such as the gas turbine, the hydraulic torque converter will continue to attract interest as a possible means of supplementing the characteristics of these new powerplants to provide a consolidated unit for automotive vehicle propulsion. From a paper by Carl A. Lindblom, White Motor Co., presented at recent SAE Washington Section meeting.

PRECISION-BUILT BY SPECIALISTS FOR SMOOTH, QUIET OPERATION



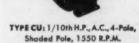
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Yes, get your hands on a Redmond Micromotor. Let Redmond "Customer Engineering Service" help you in its selection and application. Then see for yourself what a wonderful big difference the right small motor can make in the life, performance, and efficiency of your product.

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TYPE BT: 1/30th H.P., A.C., 2-Pole, Shaded Pole, 3000 R.P.M.



TYPE BL: 1/40th H.P., A.C., 2-Pole, Shaded Pole, 3000 R.P.M.



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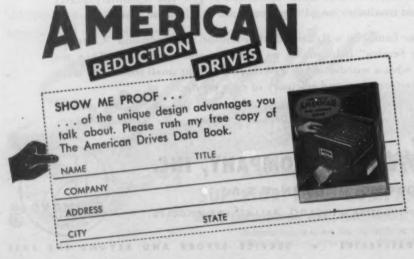


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Here is a completely STANDARD reduction drive that transforms special, slow-speed design problems into simple, efficient high-speed installations . . . using STANDARD motors, STANDARD V-Belts, STANDARD sheaves! Think of the design possibilities this compact drive gives you! No special engineering—no bulky foundations or supports are necessary. Six sizes of Reduction Units provide any speed below 154 rpm for drives up to 25 hp. Here's an amazingly different slow-speed drive—IT PUTS THE GEARS WHERE THEY BELONG—right on the shaft of the driven machine! Over 50,000 are already paying their way throughout industry.

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# MACHINES

And the Companies Behind Them

#### **Business Equipment**

BANK ACCOUNTING MACHINE, Uses 3 controls to calculate and write complete bank statements. Operating speed increased 15 per cent, handling effort reduced, and accumulating capacity tripled. Machine automatically selects correct columns on customer's statement, prints date, counts checks, tells operator if account is overdrawn and by how much, and computes and prints new balance. Detailed analysis of day's work kept in 10 "memory" sections which give total checks, deposits, overdrafts, etc., at end of day. Burroughs Adding Machine Co., Detroit, Mich.

#### Domestic

PORTABLE ELECTRIC HEATER. Rotating reflector throws both radiant and fan-forced heat. Polished aluminum fan blade operates at low speed for max air movement with greatest throw of heat. Heater rated at 1320 watts, 120-volt, a-c. General Electric Co., Bridgeport, Conn.

AUTOMATIC DISHWASHER. Self-contained unit reduces installation costs by 60 per cent. Washer built into complete sink unit with motor and pump that empty water into sink drain trap. Machine has front-opening, self-sealing door and automatic washing, rinsing and electrical drying cycle. Hotpoint Inc., Chicago, Ill.

REFRIGERATOR. New line includes 8 and 10-cu ft combination refrigerator-freezers and 8-cu ft medium-price refrigerator. Freezers have aluminum shelves, plastic food baskets and 3 ice trays. Refrigerator features stainless steel shelves, butter conditioner and storage space for 24 lb of frozen foods. Hotpoint Inc., Chicago, Ill.

#### **Earthmoving**

SHOVEL-FRONT TRACTOR ACCESSORY.
Capacity, ½ cu yd. For track
type tractors, unit may be mounted on either new or used machines
without major alteration. Well
adapted for grading, gravel pit
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TYPES—Seamless (hot finished and cold drawn). Welded (from hot or cold rolled strip).

GRADES-Carbon, Alloy, and Stainless.

SIZES-Up to 85%" O.D. in full range of wall thicknesses.

QUALITY—Open-hearth and electric furnace steels, including aircraft and magnaflux qualities.

CONDITION — Unannealed, annealed, tempered, normalized, or otherwise heat-treated as required.

SURFACE FINISHES — As rolled, as drawn, as welded, head removed, turned, scale-free, and polished.

SHAPES - Round, square, rectangular, and special shapes.



# Electrol Hydraulic Devices For Every Industrial Need



Pictured here are but a few of the many hydraulic devices produced by Electrol for industry... transportation... and agriculture. We will gladly supply further details as to the application of these units in the machines you use or the products you make. Or — better still—have our engineers work with you in adapting them to any specific design.

Allow flow in one direction and, by use of a metering device, accurately control reverse flow from 0 to valve max. — even after thousands of cycles. Flow controlled by screw-actuated metering pin. Handle air or oil, with pressures up to 1,500 p. s. i. Standard sizes: ½, ¼, ¾, ½ and ¾" N. P. T.



Provide positive sealing from low to high pressures—5,000 p. s. i. max. Used for air, gas, water and oil control with min. pressure drop and positive sealing against return flow. Standard models feature bronze and brass elements. Standard sizes: ½ to 2" N. P. T.



"500-1 Series" hydraulic cylinders available in bore diameters ranging from ¾" up to and including 3". Chromium plated piston rods, honed seamless steel tubing cylinders. Conventional "0" ring packings. Clevis mounting and standard pipe ports. Can be used in air or oil. Pressures up to 1,500 p.s.i.



Uniform two-way action for maximum operating efficiency. Low in cost, economical in operation. Few moving parts, minimum of maintenance. Operating pressure: 0 to 1,500 p. s. i. Pump delivery: 1.5 cubic inches per cycle. %" N. P. T. ports. Suction and pressure check valves built in.

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F. Shell constructed of heavy angle framework with steel plate sides. Seminozzle type burners are located to prevent flame impingement on parts being heated. Governor gives automatic control of air-gas ratio. Designed for high or low-pressure gas. Eclipse Fuel Engineering Co., Rockford, Ill.

#### Heating and Ventilating

CORE BAKING TUNNEL. Low cost unit handles cores to 16 in, wide, 7 in. high. Capacity, 375 lb of cores per hour. Unit has variable-speed dial feed, adjustable electrodes and complete blower-exhaust system. Designed for small foundry use. Induction Heating Corp., Brooklyn, N. Y.

PORTABLE VENTILATORS, Equipped with high-velocity fans powered by gas engines or electricity. Air conveyed to desired point through 14-in. diameter, 16-ft long, collapsible ducts. Ducts treated for flame and mildew resistance. Two-way air flow feature permits connecting duct to inlet or discharge side of fan. Max of 32 ft of duct can be used. Mine Safety Appliances Co., Pittsburgh, Pa.

#### Manufacturing

LAYOUT DRILLING MACHINE, For work requiring more accuracy than is possible with standard drill but not precision of jig borer. Handles drilling, boring, tapping, reaming, milling and similar operations. Equipped with combination boring and drilling spindle with No. 4 Morse taper. Sliding head has friction type feed clutch with automatic, adjustable, depth kickout; spindle is counterbalanced to eliminate backlash between spindle feed rack and pinion. Movement of saddle and table accurate to 0.001-in. in 24 in. with 6-in, diameter dials graduated to 0.001-in, and verniers to 0.0001-in. Work tolerances held to 0.001-in. per ft. Optional power rapid traverse for table movements. Cleereman Machine Tool Co., Green Bay, Wis.

PIPE FLANGE MACHINE. For boring, reaming, threading and counterboring cast iron pipe flanges. Equipped with 3-jaw scroll chuck, machine handles flanges from 3 to 16-in. pipe sizes. Machine has worm and worm gear drive head and sliding gears providing 2 speeds plus pick-off speed change gears. Baker Brothers Inc., Toledo, O.

ROLL-HANDLING TRUCK. Up-ends paper rolls or other heavy cylindrical objects from horizontal to vertical position or vice versa. Hydraulically-operated arms clamp load for turning. Handles rolls from

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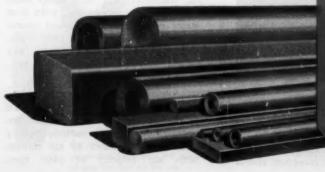
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HIGH-LIFT FORK TRUCK, Gas-powered model designed primarily for longrun, outside hauls. Powered by 17hp, air-cooled engine with generator and starter; includes automotive type transmission, clutch and brake. Overall length with 30-in. fork, 102 in.; width, 321/2 in.; max lift, 1211/2 in., total weight, 3900 Travel speed with 2000-lb capacity load, 61/2 mph; lift speed, 31 fpm; lowering speed, 35 fpm. Upright tilts forward 5 degrees, backward 10 degrees. Elwell-Parker Electric Co., Cleveland, O.

SHAPE-CUTTING MACHINE. Handles straight-line, circle and bevel cutting in addition to shape cutting. Oxyacetylene machine includes manual tracing device, torch, tip, track and hose. Cutting area, 32 in. wide by 56 in, long. Track sections enable cutting of longer lengths. Machine weight, 110 lb; weight of tubular rail on which machine travels, 35 lb. Air Reduction Sales Co., New York, N. Y.

BRAKE DRUM SUPERFINISHER, Doublespindle, 2-station machine for automotive type brake drums. Finishes drums from 150 to 30-40 microinches, rms. Produces over 6 drums per minute with 1 operator. Roughing and finishing stones timed to work together as brake drum oscillates and revolves. Spindle cycle is automatic. Gisholt Machine Co., Madison, Wis.

WIRE STRIPPER. For production stripping of insulation from ends of solid, stranded or multiconductor cable or wire to 1/2-in. diameter. Adjustable stop provides for any length stripping to 11/2 in. Circular cutting knives can be rotated slightly to give new cutting edge, or can be easily replaced. Machine direct-connected to 14-hp motor. The High Speed Hammer Co. Inc., Rochester, N. Y.

PORTABLE ELECTRIC DRILL, Weight, 31/2 lb. Capacity, 1/4-in. steel or ½-in. wood. Overall length, 7% in., diameter, 2% in. Alloy steel double-reduction gearing, with first stage gears helical for quiet operation. No-load speed, 1600 rpm. Equipped with Jacobs hex key Fasco chuck. Industries Inc., Rochester, N. Y.

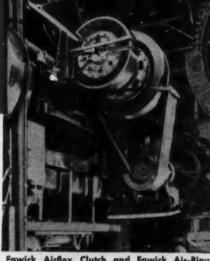
HIGH-SPEED GRINDER. Operates at 38,-000 rpm from 110 to 130-volt, a-c or d-c power. For rough and finish grinding with carbide rotary files. Motor cooled by air stream with air velocity of 5400 fpm.



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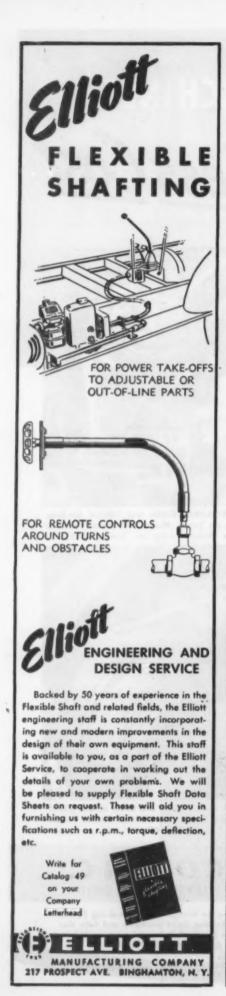
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ENGAGED POSITION Od gir,

Releasing air through the instant-acting Fawick Quick Release Valve promptly and fully disengages the clutch, lets it ride completely free, without drag, or mechanical contact.

DISENGAGED POSITION

Expanding under force of compressed air, the rubber-and-fabric tube smoothly engages the clutch with the precise degree of grip required by the job.



Weight, 13 oz; length, 6% in. Handles 3/32 and %-in. collets. Metal Removal Co., Chicago, Ill.

ALL-PURPOSE HAND TOOL. Electric drill-saw combines rotary action for drilling, sanding, grinding, etc. with reciprocating motion for sawing, filing, honing, etc. Portable; weighs 6½ lb. Reciprocating motion gives 2000 strokes per minute, 7/16-in. long. Sheldon Products Co., Cleveland, O.

HIGH-SPEED GRINDER. Pneumatic, 15oz model for grinding wheels of
½-in. diameter and smaller. Ideal
for touching up dies and similar
tool room work. Spindle speed,
75,000 rpm. Inverted throttle lever
provides operating control. Standard collet takes mounted grinding
wheels with ½-in. shank. Optional
collet chucks take 3/16 or ½-in.
diameter shanks. Keller Tool Co.,
Grand Haven, Mich.

GENERAL PURPOSE MACHINE. Heavyduty, vertical milling, drilling and boring machine. Equipped with variable-speed motors or with constant-speed motors for specialized production work. Table and saddle travel on rollers and are designed to eliminate overhang. Speed and feed changes electronically controlled and may be changed with machine operating. Control panel can be moved to any position convenient to operator. Safety switch on panel stops all machine drives. W. B. Knight Machinery Co., St. Louis. Mo.

ABRASIVE CUTTING MACHINE. For wet or dry cutting of tubes, angles, bar stock, etc. Handles ferrous or nonferrous materials. Cuts lightwall tubing to 1½-in. diameter and solid bar stock to ¾-in. diameter with 3-hp motor. Cuts light-wall tubing to 2-in. diameter or solid bar to 1-in. diameter with 5-hp motor. Suitable abrasive wheels keep burr to minimum. American Chain & Cable Co. Inc., Bridgeport, Conn.

PRESS BRAKES. High-speed models provide to 80 strokes per minute. Capacity, 35 tons. Die area, 15 by 42 in. Larger tonnages and die areas available. Press-control safety mechanism may be set for continuous operation or to stop at top of stroke. Excessive loads automatically throw out clutch. Machine provides flexible ram setting, low die cost and good operator convenience. The Cyril Bath Co., Cleveland, O.

HORIZONTAL THREADING MACHINE.

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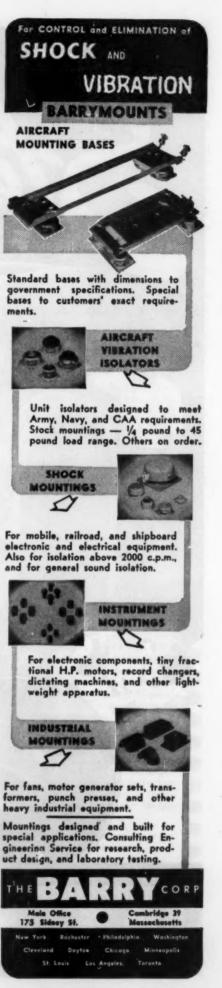
1321 Oberlin Ave. Lorgin, Ohio, U. S. A. on each of 12 spindles, 6 on each side, provided with lead screw feed. Workpieces loaded by operator at open station while machine is operating. Production capacity, 1060 suspension arms per hour; up to 1500 pieces per hour possible depending on part. Davis & Thompson Co., Milwaukee, Wis.

AUTOMATIC BENDING MACHINE. Highspeed, hydraulic machine for bending tube to 3-in. OD with ¼-in.
wall thickness (or larger tubes of
same area) and other miscellaneous bending. Equipped with 6 automatic stops for various degrees
of bend. Machine indexes automatically, bends either right or left
with standard dies and can be furnished with hand control and automatic mandrel ejector. Acme-Winter Corp., Buffalo, N. Y.

LATHES. For large diameter work that is not excessively heavy. Max swing over carriage, 241/4 in.; over saddle cross slide with chip guard, 18% in. Distance between centers, 30 to 102 in. Includes 16 spindle speeds ranging from 11 to 727 rpm, longitudinal power feeds from 0.0015 to 0.0841-in. per revolution, and cross feeds from 0.0006 to 0.0312-in. per revolution. Quickchange gear mechanism provides 48 pitches of screw threads from 4 to 224 per in, Powered by 2-hp motor mounted under headstock. South Bend Lathe Works, South Bend. Ind.

UNIVERSAL DRILLING AND TAPPING MACHINE. Provides 97-in. radial reach; drills holes from 18 to 134 in, above floor with spindle in horizontal position. Machine has 4-in. diameter nitrided spindle with 18in. manual and power feed, spindle speeds from 25 to 800 rpm, spindle hp of 10 to 20. Spindle head swivels 360 degrees on trunnion, trunnion rotates 180 degrees on rails. Both swiveling units are power driven. Entire rail unit of spindle head, spindle drive and transmission has 60-in. vertical movement on column with rapid traverse up and down. Column base has 48-in. horizontal travel on runway. Choice of 9 spindle feeds and nine speeds. Kaukauna Machine Corp., Kaukauna, Wis.

TURRET LATHE. Saddle type universal machine has 21-in, bar and 12-in. chuck capacity. Weight, 4½ tons without tooling. Threading to max turning length with carriage or saddle made possible with full length lead screw. Sliding-gear, quick-change gearbox has single-lever pitch selector. Cross slide and saddle equipped with power rapid traverse; turret is power indexed. Two ranges of 12 spindle



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INJECTION MOLDING PRESS. Hand-operated, low-cost unit for thermoplastic materials moldable between 250 and 500 F. Capacity, ¼-oz. For experimental, test, sample or short-run molding. Thermostatically-controlled heating element built around cylinder where molding materials are heated to flow point. Unit has 3-in. stroke, is 10 in. high; weighs 2 lb. Plastics Development Corp., New York, N. Y.

AIR JET HEATER. Developed primarily for welding and sealing of plastics. Also useful for general laboratory work, spot heating, curing of adhesives, paint removal, etc. Delivers flameless jet of air or gas at temperatures to 700 F and pressures from 5 to 40 psi. Electric heating elements heat air from external source in 3-pass heat exchanger. Unit is portable. DeBell & Richardson Inc., Hazardville,

PORTABLE SPOT WELDER. Weight, 22 lb. Welds 2 sheets of any weldable 20 to 18 gage steel, galvanized iron, Monel and Hoskins alloys, and stainless steel 2 gages thicker. Optional 220-volt unit welds to 1/4in. thickness. Dimensions, 4 by 4 by 15 in. Unit requires only 1 hand to operate. Tool & Equipment Distributors, La Grange, Ill.

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TRACTOR-TRUCK. For materials handling in construction or industrial fields. With 2/3-yd capacity dump body, or platform body with removable steel sides and end gates. Includes 3 speeds forward and reverse, max speed of 15 mph, turning radius of 78½ in. Capacity, 3000 lb with 13-hp, air-cooled motor. Wheel base, 56 in. Dimensions: length, 85½ in.; height to top of box, 41¾ in.; width, 42 in.; overall height, 50¼ in.; and ground clearance, 7½ in. Kalamazoo Manufacturing Co., Kalamazoo, Mich.

DIE-HANDLING LIFT TRUCK. Capacity, 110,000 lb. Platform 93 by 69 in. lifts from 26 to 60 in. Weight of empty truck, 40,000 lb. Powered by 72-volt battery, enabling load to be lifted at 2.7 fpm. Max truck dimensions, 85 in. wide by 184 in. long. Winch attachment used for maneuvering dies off of press. Automatic Transportation Co., Chicago, Ill.

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of platform to permit carrying long loads on opposite side. Overall length, 104% in.; load area on 56 in. long platform, 20 sq ft; height of platform, 18% in. Dead-man control and safety interlock obtained through foot switch. Steered by horizontal tiller. Battery rated at 36 volts, 192 to 281 amp-hr capacity. Baker Industrial Truck Div., The Baker-Raulang Co., Cleveland, O.

PAPER ROLL TRUCK. For positioning of rolls of paper weighing to 500 lb. Platform 30 in, wide has 20 in. concave surface designed to fit 36-in. diameter rolls. Platform drops to floor, lip forms ramp to roll paper onto carriage. Hand-operated hydraulic hoist lifts platform 28 in. Lyon-Raymond Corp., Greene, N. Y.

ELEVATOR FORK LIFT TRUCK. For raising loads from first floor to balcony storage areas. Special nontilt mast and carriage assembly permit lowering forks to 98 in. below balcony floor level and lifting to 10 in. above balcony floor. Capacity, 2000 lb. Towmotor Corp., Cleveland, O.

#### Plant Equipment

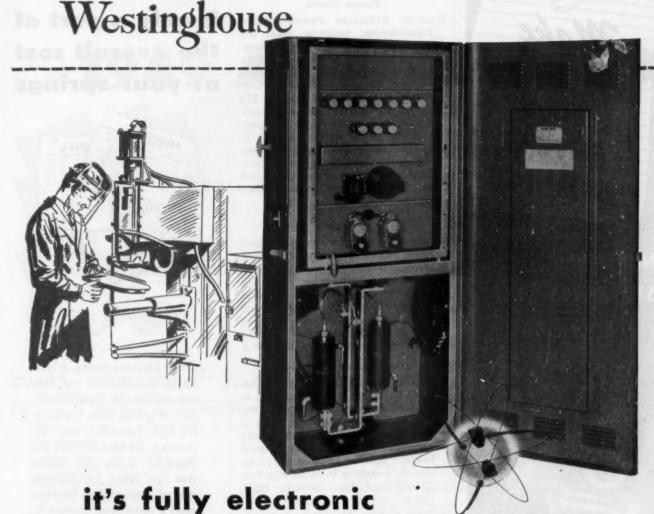
BROACH RESHARPENING MACHINE, For cylindrical, internal broaches. One model handles round type broaches to 9 in. diameter and 84 in. long; another model handles work to 9 in. diameter and 60 in. long. Work mounted between centers, grinding wheel traverses from tooth to tooth. Includes micrometer-dial control wheels for lateral traverse of carriage and infeed of grinding spindle and variable-speed drive for broach rotation. American Broach & Machine Co., Ann Arbor, Mich.

PORTABLE VACUUM CLEANER. For cleaning in confined areas, stock bins, under machinery, etc. In 1/3, 3/5, 1 and 11/3-hp sizes. Designed for 53 to 86 cfm of air. Includes 20 ft of special heavy-duty cable, shoulder strap, 4 ft flexible rubber hose and nozzles. Can also be used for insecticide or paint spraying. Breuer Electric Mfg. Co., Chicago, Ill.

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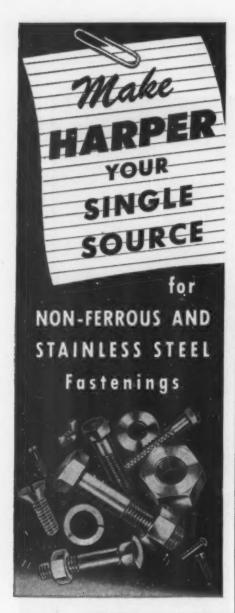
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#### **Processing**

CHEESE PRESS. Hydraulically-operated model constructed from stainless steel. Handles all popular cheese hoops without alteration. Does not use ratchets; movable back plate and double-acting pistons provide pressing force. Pistons operate on air or water pressure. Damrow Brothers Co., Fond du Lac, Wis.

#### Testing and Inspection

TEST CHAMBER. For temperature-controlled testing in laboratory or production work. Permits testing at temperatures between -65 F and 275 F. Cooling obtained with carbon dioxide ice, heating by strip heater. Handles loads of 600 cu in. volume weighing to 10 lb. Statham Laboratories Inc., Beverly Hills, Calif.

TAPPET GAGING MACHINE. Automatically checks critical dimensions on automotive valve tappets and segregates acceptable, rejected and salvageable parts. Capacity, 2000 parts per hour. Gages external diameter at each end, internal diameters, checks solid end face for squareness with bore, and checks overall length. Machine also checks concentricity of bore with outside diameter on half of otherwise acceptable parts. Consists of 5 load, 5 gaging, 5 segregating and 2 unloading stations. The Sheffield Corp., Dayton, O.

TIME INTERVAL COUNTER. For precision electronic counting, timing or computing. Counts at rates to 1 million per second. No moving parts; simply actuated by electrical impulses. Uses positive pulse for both timing and counting operations. Temperature - controlled crystal oscillator serves as timing element; when used as counter. timing circuit is bypassed and pulses to be counted are fed to multivibrator counting circuits. RCA Victor Div., Radio Corp. of America, Camden, N. J.

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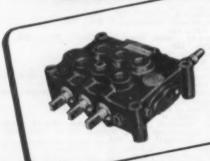
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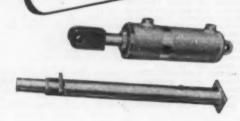
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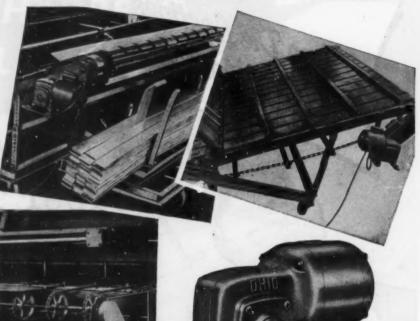
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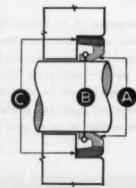
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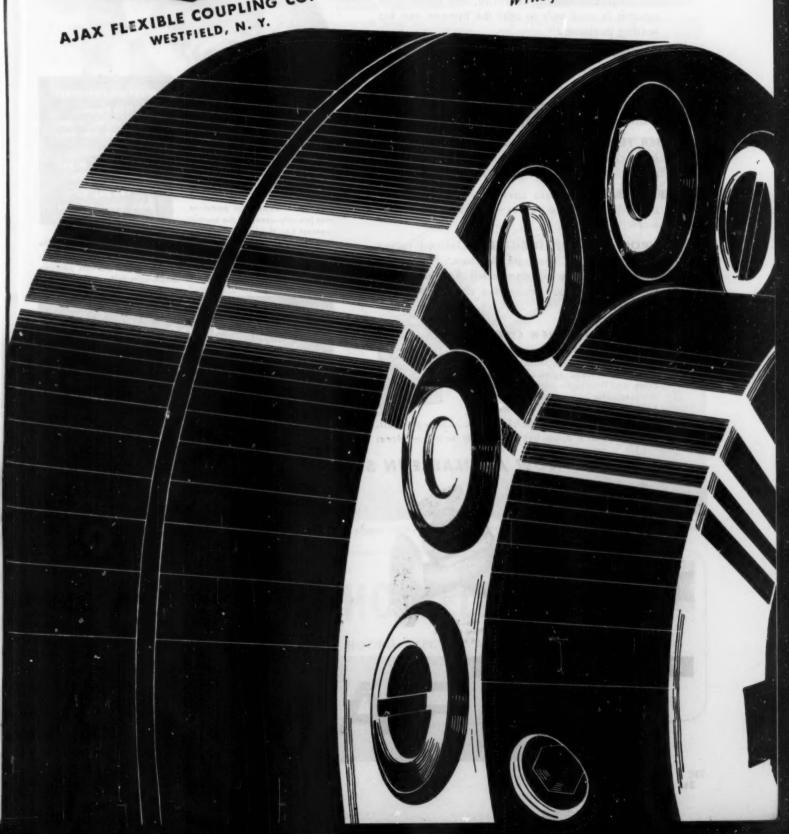
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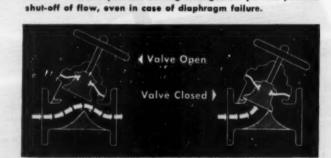
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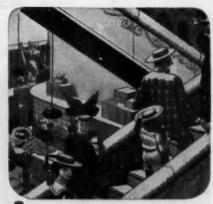
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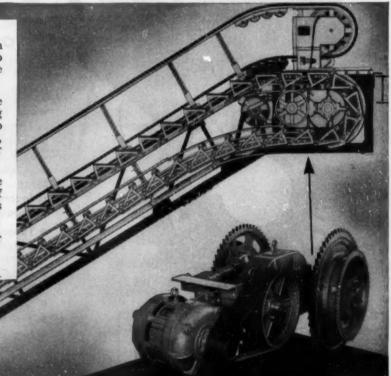
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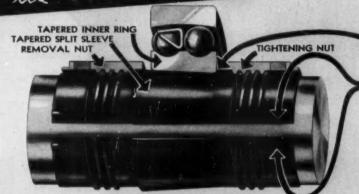
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Designated as type SUA with ball bearings—and type SUAR with spherical roller bearings.



# its CONSTRUCTION



TIGHT FIT results when the tightening nut pushes the tapered inner ring over the tapered split sleeve.

CONCENTRIC GRIP is firm and positive—as the split sleeve contracts and wraps around the shaft. Removal is accomplished by reversing the process—with tightening nut loosened, removal nut pushes inner ring off the sleeve.

# its APPLICATION

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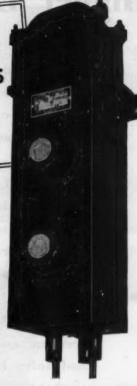
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DISTRICTIVE FEATURES — The soft steel blades are made in pairs, pressed thru slots in the heavy steel back plate, then welded to the plate. The blade tips are pressed thru slots in the inlet disc then bent back against the spring of the steel blades. This patented construction results in an exceptionally rigid wheel and prevents lease blades, as no rivets are used in fastening the blades. The heavy cast iron machined hub is riveted to the back plate and will not crack or become lesse on the shaft.

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# It PAYS to work with an MB Vibration Exciter

You can save time, eliminate tedious calculations, and improve your product with the help of an MB electromagnetic shaker. Note how these benefits add up in the following typical applications—just three of many uses for this quality-control and research "tool."



MODEL 3A VIERATION EXCITER Delivers 3 pounds force from 20 to 1,000 c.p.s., usable to 20,000 c.p.s.

indefatigable fatigue tester — Here is the endurance tester to show up quickly those faults which often result in failures under dynamic stresses. Why risk trouble reports? You can shake such parts as axles, brackets, complete assemblies, housings, castings and make improvements before full scale production—before the remedy becomes costly.

NOISE LOCATER — Operating silently, the MB Exciter reveals sources of noise in equipment of all types. Because you can "scan" a product's operating frequency range, you can put your finger right on resonant



trouble areas. Less noise means more customer satisfaction.

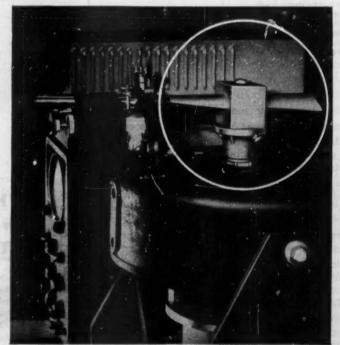
shake out the "Bugs" - Electrical and sensitive components can be checked for ability to withstand severe vibratory service conditions. Reproduce the effect of years of vibration on your product within hours!

You'll find MB Vibration Exciters at work for many leading companies recognized for the quality of their engineering. Would you like to know how to apply one to your own problems? An MB engineer will be glad to show you—without obligation.



MODEL S3 VIBRATION EXCITER Delivers controlled force up to 200 pounds, in frequency range of 3 to 500 c.p.s.

Testing of small turbine blades (encircled) mounted on an MB Model C-1 Exciter which delivers 25 pounds force in range of 4 to 500 c.p.s. (and higher). Using stroboscopic lighting, resonances and deflections are studied visually—and any need for corrections determined quickly. A stronger, stiffer blade is sure to result.





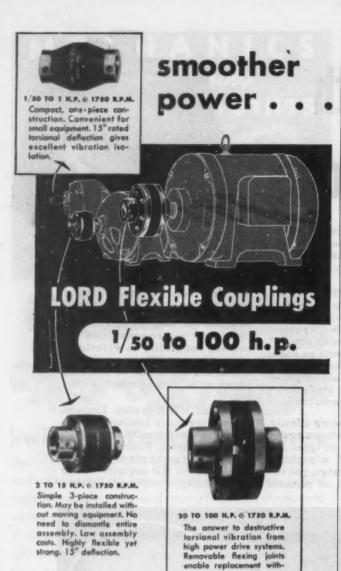
#### DO YOU HAVE OUR NEW BULLETIN ON FILE?

It contains helpful design data on vibration control, plus more information on the line of MB Exciters. Write for your copy today. Ask for bulletin No. 410-G3.



#### MANUFACTURING COMPANY, Inc.

1060 State St., New Haven 11, Conn.



The development of Lord M.H.P. Couplings completes the line of Lord Flexible Couplings from 1/50 to 100 h.p. and greatly extends the possibilities for product improvement and customer appeal.

ut moving equipment.

Large torsional deflection assures an even flow of power from motor to driven equipment. The Neoprene flexing element is oil resistant . . . there are no bearing surfaces to chafe . . . no lubrication is required. Lord M.H.P. Couplings are permanently quiet . . . they are unaffected by sand, emery, or other abrasives.

Simple construction and a high degree of accommodation to angular and parallel misalignment reduce assembly costs. It will pay you to investigate the advantages of incorporating Lord M.H.P. Couplings in your product design.

Bulletin 201 describes the complete line of Lord Flexible Couplings. See our bulletin in Sweet's 1949 File for Product Designers or write for Bulletin 900 showing Lord Vibration Control Mountings and other Bonded Rubber Products.

LORD MANUFACTURING COMPANY . ERIE, PA. Canadian Representative: Railway & Power Engineering Corp. Ltd.

LORD Vibration Control Systems

#### SPECIFY alliance motors for

#### Small Load Jobs!

**Business Machines** Vending Machines Controls **Heating Appliances Turntables** 

Radio & television tuning Other appliances

Mass production of small motors for mass markets at low cost—that's the job at Alliancel

Ailiance motors rated from less than 1/400 h.p. on up to 1/25 h.p. are made semi-open, and fully enclosed. Some are uni-directional and others are reversible. Motors are designed for both continuous and intermittent duty loads. Covering a wide range of standard AC voltages and frequencies, Alliance offers motors of varied types with operating characteristics to fit the specific needs of small loads. Individual changes in design are available where quantity warrants.

Check these advantages! Low operating cost Low induced hum Low magnetic field Low first cost Cool running-guiet Flexible power range Slower controlled speeds Long life

Write for catalog and specifications

MODEL B

4-pole shaded pole motor. Approx. 1/30 h.p. 1550 r.p.m.





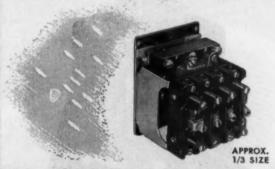
MODEL A

6-pole shaded pole motor. Approx. 1/30 h.p. 500 to 1050 r.p.m.

#### € MODEL MS

2-pole shaded pole motor — full load h.p. .0021. Full load 2800

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R-B-M Industrial Contactors, with interchangeable normally open and normally closed contacts, can be mounted in minimum space without sacrificing accessibility. You will also find that the initial low cost of R-B-M, plus long and dependable performance, will save you money.

Available in 10 and 15 ampere sizes, 600 volt A.C., 2 to 8 pole non-reversing-2 to 4 pole reversing. Open and enclosed types. Write for Bulletin and Price List on your company letterhead.

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AUTOMATIC
DRILLING
& TAPPING
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Hartford Special Drilling and Tapping Machines are designed to take the guesswork out of production. Packaged Engineering includes all the thinking and building necessary to put a self-contained unit in your hands. Sequence of operations and overall design are calculated to reduce waste motion and time to a minimum, yet keep the machine compact and simple to operate. These machines are built to be as rugged and foolproof as modern mechanical skill can make them, because a machine that is down is not producing. If you are considering a special single-purpose machine, you can be sure that Hartford Special will examine every angle to give your production a real boost. Write our Engineering Department now. The Hartford Special Machinery Company, Hartford 5. Connecticut.

This machine drills 11 holes, counterbores 3, and taps 5 with nine drilling units and two tapping units. One drilling unit uses a four spindle attachable head, and one tapping unit has an eight spindle attachable head. The eight station dial indexing mechanism is motor driven, and the entire machine is electrically interlocked.



For special applications, Drilling and Tapping Units with or without attachable heads are available individually.



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FOR POWER CONTROL DESIGNS

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SINGLE REVOLUTION CLUTCH

Unequalled for accurate control of intermittent machine operations — cutting, punching, and packaging. Gives closer tolerances to

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Hilliard Over-Running Clutches and Couplings are automatic in operation. They are unexcelled for automatic two-speed drives, dual drives, stand-by drives,

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A reliable series of springloaded slip clutches and couplings. Rugged construction with ample friction surface for heavy-duty use. Outstanding for preventing overloads and shocks; for

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Hilliard's Engineering Department is ready to assist you in designing installations and in selecting the correct clutch or coupling.

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fit your particular needs can be designed without undue expense. The adaptability of Euclid Universals often makes special design unnecessary. A Euclid engineer can analyze your needs and recommend the right Euclid Speed Reducer to fit your application. Your inquiry is solicited.

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Special heavy duty worm gear reducer with oversize worm shaft for use with heavy torque loads.

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# Pick the Rectifier to fit your need

Each of these three popular metallic rectifiers, copper oxide, low-voltage selenium, and high-voltage selenium, has its own characteristics which make it a better rectifier for a particular application. As the best choice depends on the desired application characteristics, here are some general characteristics:

#### Characteristics

#### Copper Oxide

Always formed blocking layer

Heavy overload, voltage and current,
of short duration

High efficiency at high current densities

Stabilized "aging" after few months

Continuous service

Long life

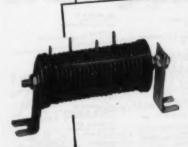
#### Application

Blocking relays in control circuits
Circuit breaker
Plating equipment
Exciter circuits
Relay power supply
Battery chargers



#### Low-voltage Selenium .

Generally offers the best compromise between the features of high-voltage selenium and stability of efficiency of copper oxide. Cathodic protection Magnetic separators Battery eliminators Elevator controls



#### High-voltage Selenium

Smaller in size per volt over 12
Light weight
High voltage, low current
Suitable for economical intermittent
service over 12 volts

Calculating machines
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To fully meet your needs, General Electric makes all three types. If you have a rectifier problem, bring it to us—we play no favorites, we will give you an impartial recommendation. Contact your local G-E Apparatus Agent, or write Apparatus Dept., General Electric Co., Schenectady 5, N. Y.

GENERAL ELECTRIC



secure positive, efficient, troublefree power transmission.

Curtis Universals insure delivery of positive rotation to driven shaft from driving shaft and can permit compensation for variations in distances between shaft ends where necessary.

Curtis Quality Universal Joints contribute to efficient, smooth performance and low maintenance of your machine tools, electronic apparatus, transformer tap changers, multi-spindle drill heads, etc. Machined to

the closest practical tolerances from special heat treated alloy steels, the precision and quality of Curtis Universals are zealously watched by experienced craftsmen - many of whom have been with Curtis for years.

Available from stock in 14 sizes. Either single or double, furnished with solid hubs or with hubs bored one half the O.D. Be sure of the best - Specify Curtis.

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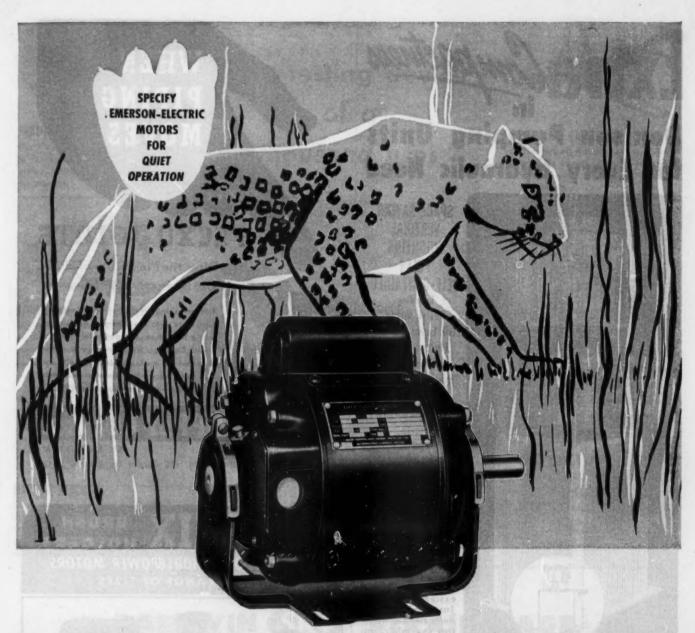
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PUMP COMPANY Cedar Falls, Iowa



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hundreds of exacting tests and inspections at every stage of production... and backed by unsurpassed research and designing facilities, plus experience.

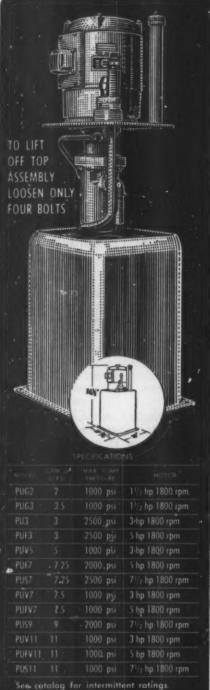
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for Every Hydraulic Need



SPACE-SAVING VERTICAL MOUNTING FULLY SELF-CONTAINED

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For conveying pressures through moving pipe lines or to machinery or equipment while in motion, use dependable Flexo Joints. Complete 360° movement in either direction for pressures from gravity up . . . long wear—low maintenance cost. Four styles—standard pipe sizes 1/4" to 3".



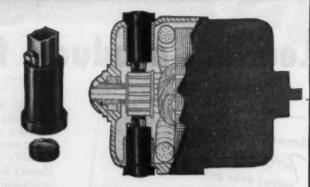
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PHOENIX Brush-Holders have been used for years by many of the country's leading motor manufacturers. They have proven themselves in the field under almost every condition.

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#### PRODUCT IMPROVEMENT

The Automotive Industry uses the SR-4 to check stresses and strains in vital parts, eliminate weaknesses, improve the product.

# The testing device of a thousand uses



#### AIRCRAFT LIGHTENING

The Aircraft industry uses the SR-4 to plot the complex flow of stresses in aircraft wings during flight, "balance" the design.



#### STRUCTURAL STRESS ANALYSIS

Engineering organizations check theoretical stress distribution against actual patterns, to verify design practice.



#### MACHINE REDESIGN

Equipment manufacturers use the SR-4 to isolate the cause of puzzling breakages and to point the way to a correct solution.



#### MASONRY STRESS DETERMINATION

The heavy construction industry is learning valuable new facts on how masonry withstands loading . . . with the SR-4.



#### MAKING BALLISTICS STUDIES

The flow of stress in a gun barrel as the bullet passed through was once a matter of theory...but a matter of accurate knowledge now, because of the SR-4.

### BALDWIN GROS STRAIN GAGE

It's hard to believe—yet this one little testing device, no larger than a postage stamp, has done more to broaden engineering knowledge through product analysis than all other testing equipment combined:

It has provided—for the first time—an accurate picture of actual stress distribution in such structural, equipment and machine parts as an airplane wing in flight... the interior of a mammoth masonry dam... the barrel of a cannon when the shell flashes from breech to muzzle... the frame of a punch press... the connecting rods of diesel engines during operation. In every instance, the new knowledge it revealed has permitted engineers to better the design job.

The long list of successful uses does not define the ultimate applications of the Baldwin SR-4 strain gage, but merely indicates its almost limitless possibilities. If you have any problem where unexplainable failures of parts are puzzling you . . . where some equipment must be lightened while retaining balanced strength . . . where a complete report of actual stress distribution in a structure will aid you in design . . . the Baldwin SR-4 can undoubtedly help you, as it has helped many others.



A comprehensive line of indicating, recording and switching instruments and equipment is available for both laboratory and field studies. The units illustrated include an SR-4 Strain Recorder Chart, and SR-4 Portable Strain Indicator, and an SR-4 Switching Unit, with which 48 strain gages can be switched in and out of service in as little as 50 seconds. These are only a few of many.

ASK FOR LITERATURE. Informative

Technical Bulletins give a concise technical description of the SR-4 and collateral equipment. Ask for copies, indicating the type of testing in which you are interested.

The Baldwin Locomotive Works, Philadelphia 42, Pa., U. S. A. Offices: Boston, Chicago, Cleveland, Houston, New York, Philadelphia, Pittsburgh, San Francisco, Seattle, St. Louis, Washington. In Canada: Peacock Brothers, Ltd., Montreal, Quebec.

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TESTING HEADQUARTERS

BALDWIN



# Save 1/3 in Space



Simplified design and elimination of tie-rods saves you up to 1/3 in space required for installation of these new hydraulic, water



or air cylinders.

No bolts or screws . . .circumferential keys allow repacking in a matter of minutes. All machined steel with bronze bearing surfaces. Ports adjustable to any angle. Simplified cushion, no ball check required. Mountings interchangeable without dissassembling cylinder. 1,500 cycles per minute continuous duty guaranteed.

Write for details today!

#### ORTMAN-MILLER

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of Sibley Machine
A Foundry Corp.

economical to operate. To end
your coolant worries insist on Ruthman Gusher
Coolant Pumps en all your metal cutting
equipment.

Write for our new Catalog today.

Illustrated is a Sibley model C-20 Drilling machine equipped with model 1-P3-9030 Shart 1/10 HP Authman Gusher Coolant Pump



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#### U. S. AIR FORCE

# "Yellow Dot

2%



# THIS RELAY IS GOOD!

The coveted "Yellow Dot" signifies this relay meets USAF requirements for reliable operation under extremes of altitude, temperature, humidity, shock and vibration.

Whether or not your product is destined for Air Force applications, you benefit by using a relay which has type approval under such exacting specifications.

The hermetically sealed Class "S" Relay at the left is USAF Type S49B6901, 24-volt DC coil, 4-pole double throw contact spring combination, wired and terminated as shown.

Other telephone type relays can be supplied with or without hermetically sealed enclosures. For additional information, send for Circulars 1700 and 1702. Write AUTOMATIC ELECTRIC SALES CORPORATION, 1033 W. Van Buren St., Chicago 7, Illinois. In Canada: Automatic Electric (Canada) Limited, Toronto.







Each of our broad group Solenoid Valves can contribute automatic, efficient control the handling of most chemicals, both liquid and gas.

- We can provide Safety Shut-Off and Trip Valves. Safety Shut-Off Valves are generally installed for emergency only, either closing tight or opening fully upon being de-energized. Trip Valves operate or "rip" upon momentary application of current.
- We can provide packed and packless Shut-Off Valves, used to automatically control the flow of liquid or gas in one direction.
- We can provide 2, 3 and 4 way pilot valves and pilot controlled diaphragm valves for controlling the low of liquid or gas in connection with cyclic operations.
- We can provide special valves in all classifications, if standard valves will not fill requirements.
- We can provide most valves in the above groups in Explosion-Proof Design, making them safe to use for it e Class 1, Group D Hazardous Locations as defined by Underwriters'.

In short, in the SCD Salthoid Valve line you will be able to find a reliable, efficient, automatic control of the flow of practically any lauid or gets. If you will write us about your requirements, we shall be clad to give you our recommendations. Also, send you a copy of our Condensed Catalog 200-R.



Automatic Switch Co.

387 Lakeside Avenue \* Orange, New Jersey





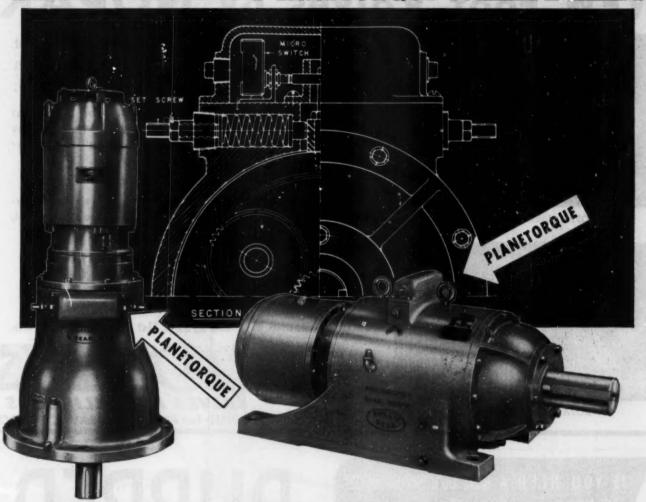
This modern "Concrete Cart" built by Modern Welding & Mfg.
Co., and powered by a Wisconsin Heavy-Duty Air-Cooled Engine, is another typical example of the added economy... savings in time and labor made possible by power equipment!

Buyers and builders of equipment welcome Wisconsin power because of the delivered dependability . . . year-in and year-out reliability gained through such features as freeze-proof, heat-proof air-cooling, sub-zero to 140° . . . Timken tapered roller bearings at BOTH ends of the crankshaft, taking up ALL thrusts . . . and the high-tension, rotary-type OUTSIDE magneto with impulse coupling, assuring all-weather quick starting and steady running.

Write today for information! 4-cycle, single-cylinder, two-cylinder, and V-type four-cylinder models, 2 to 30 hp.



### PHILADELPHIA PLANETORQUE MOTO LUCER



#### .. GIVES INSTANT OVERLOAD PROTECTION

The **PlaneTorque** is a feature that may be supplied with any Philadelphia MotoReduceR (combined motor and speed reducer) to protect both the driven machinery and the drive unit from overloads.

By direct mechanical action of the overload, motor current is automatically and instantly cut off when a pre-determined limit is reached. This action is quicker than electrical thermal relays provide. (With fuse protection, the fuses must be selected to carry the starting current of the motor; therefore, protection during running period is not adequate.)

The PlaneTorque can be cut-out during the starting period merely by holding down the starting button, but will become operative during the running period when the button is released. To restart the PlaneTorque MotoReduceR after overload cut-off, only removal of the excessive load is necessary... a big time saving feature.

For applications such as stoker drives, conveyor drives, mixers, agitators, roll drives, etc. . . . investigate the PlaneTorque MotoReduceR.



Send for new Catalog MR-49, and please use your Business Letterhead when writing.

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Industrial Gears and Speed Reducers LimiTorque Valve Controls

# NEW Foot Valves by NOPAK



NOPAE Model "F" Foot Valve



NOPAK Model "R" Foot Valve

These new Model "F" and Model "R" Foot Valves embody a number of installation and operating advantages which include:

- Eliminating the internal exhaust core in the valve disc.
- Larger effective exhaust area . . . increases valve capacity.
- Reduced possibility of plugged passages.
- "Exhaust" port located at top of valve, between the two "cylinder" ports, simplifies piping.
- Reduced overall height.
- Compact streamlined appearance, more eye-appeal.

Designed primarily for air service, both valves may be adapted to oil or water hydraulic service, for pressures up to 100 P.S.I., at slight extra cost. For complete Description and Specifications, see NOPAK Foot Valve Bulletin.

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WRITE FOR NOPAK APPLICATION MANUAL

Representatives in **Principal Cities** 



A 5626-1/2H-AA



#### SENSATION MONO-CYCLE ENGINE HAS MANY FEATURES YOU'LL WANT TO KNOW ABOUT

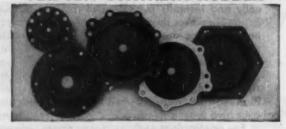
You'll like the construction of the Sensation Mono-Cycle Engine. Because it is built of light-weight metals and its design embodies fewer parts, Sensation delivers more horsepower per pound of weight than any competitive engine. Sensation holds world's endurance record... uses forged steel con red and 4320 shaft.

Versatile—Yes. Sensation operates in vertical or horizontal position or at any angle in between Compact—12 inches wide, 11½ inches high—it can be adopted to many unusual uses.

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NAME			TITLE
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PRECISION-MOLDED FROM NATURAL AND ANY SYNTHETIC RUBBER



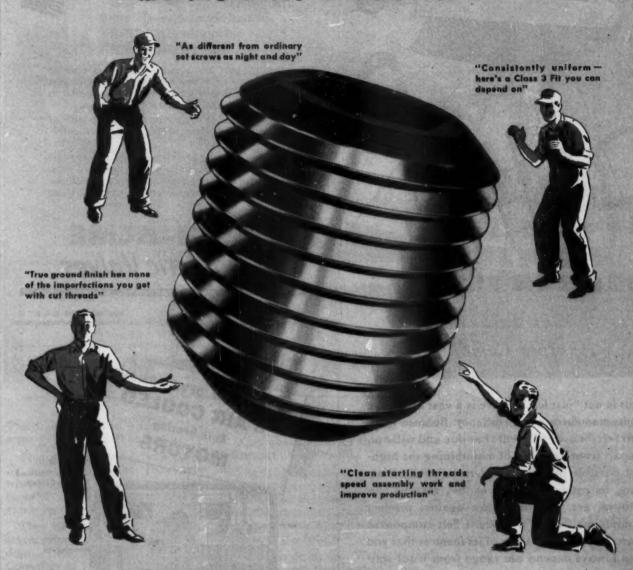
DIAPHRAGMS. We produce diaphragms of all types, with ar without fabric insert, from the size of a dime up to three feet in diameter. Special stocks are compounded to resist various fluids, extremely high and low temperatures, continued flexing, ar combinations of these requirements.

ACUSHNET problems involving the most meticulous specifications. Diaphragms are not made

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# Parker-Kalon GROUND THREAD Socket Set Screws are The TALK of the SHOP!



#### Compare! Write for Samples!

See why P-K Ground Thread Socket Set Screws speed assemblies, improve strength and safety. Thread grinding, once reserved for screws used in the finest precision equipment, now gives Parker-Kalon Socket Set Screws the accurate finish and faultless contour that mean faster assembly and more sales for your products. Write for samples today.

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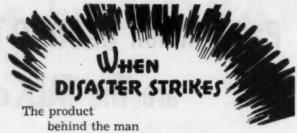
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Felt is not "just felt." There is a vast difference in its manufacture and efficiency. Because Western Felt for over fifty years has not, and will not, depart from its policy of maintaining the highest possible quality in material and manufacture, its products, wherever they may be employed, are your insurance against product complaints due to a Western Felt component part. Here are just a few of its features that you can always depend on: range from wool softness to rock hardness-never loses shapedoes not ravel or fray-resists oil, water, heat, age-resilient, flexible, compressible-may be cut to extremely close tolerances for small parts-unsurpassed in uniformity. Western Felt engineers with decades of experience in the use of felt stand ready to counsel you.

1018





behind the DISASTER
IN THE HEADLINES . .

Every result has a cause—and when disaster strikes, we know that somewhere along the line there was a man who didn't think through to what might happen before it did happen.

We remember this truism with a deep sense of responsibility when making Cash-Acme valves for industry.

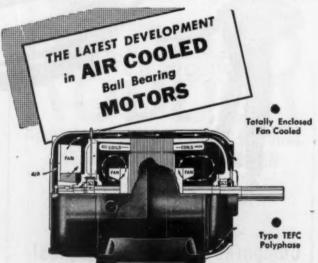
And when our valves leave the factory en route to your plant, we know that so-far is so-good. You have selected a dependable product and gone far to guarantee the safety of human life and property entrusted to your judgment.

# CASH-ACME Automatic Valves

A W CASH VALVE MANUFACTURING CORPORATION

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Here is the newest and most successful development in air cooled motors. Totally enclosed, constant speed, continuous duty; it is designed for cooler and more economical operation under the hardships of extreme heat and dust. Fully ball bearing and quiet running, too. You will want to know more about this new VALLEY Motor.

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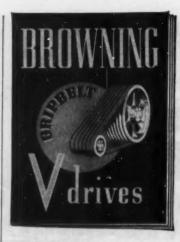
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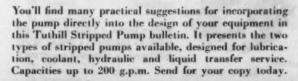
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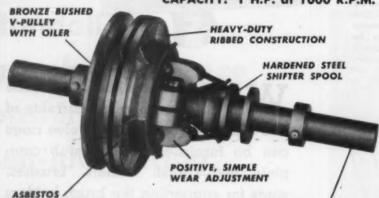




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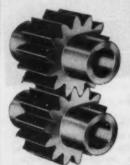


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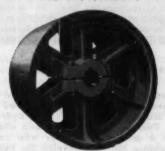
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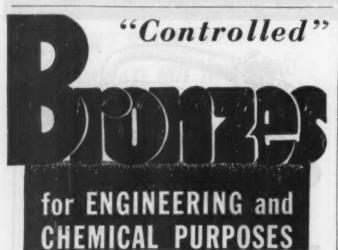
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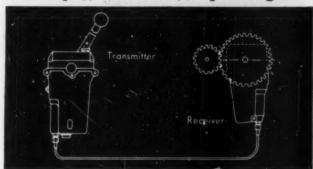
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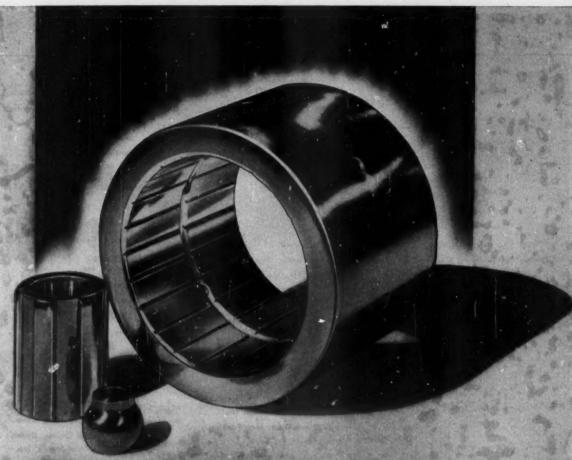


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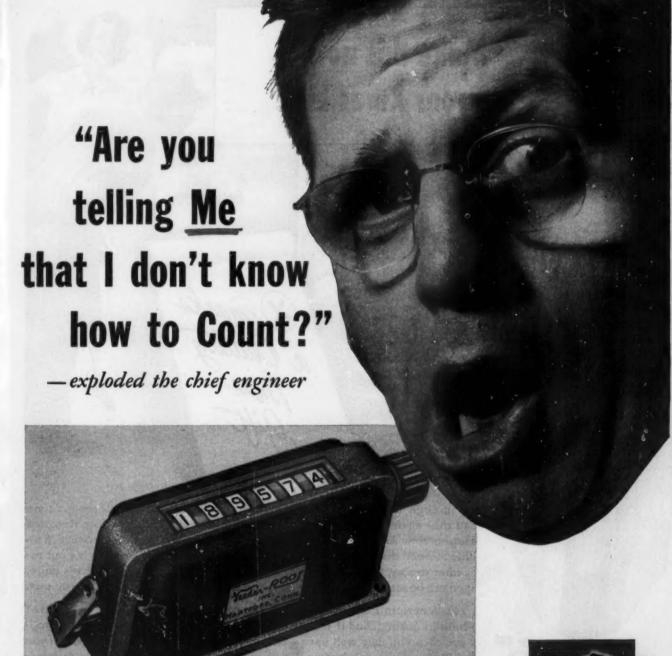
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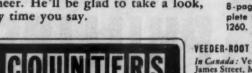
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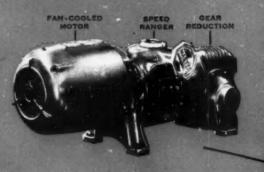
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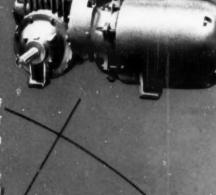
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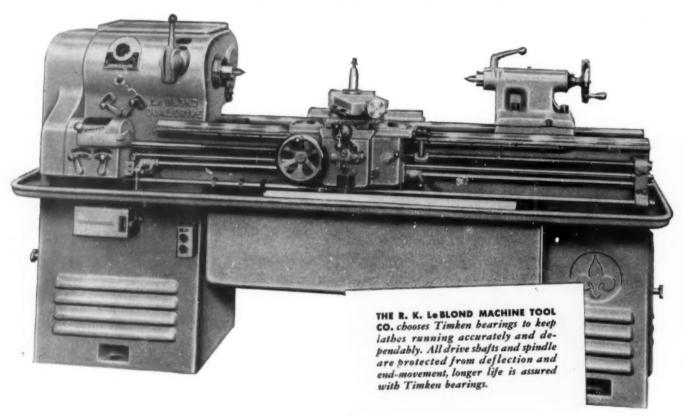
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